Submitted Via eRulemaking Portal
Administrator Andrew Wheeler
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Mail Code 28221T
Washington, D.C. 20460
Attn: Docket ID No. EPA-HQ-OAR-2018-0775

Dear Administrator Wheeler:

The U.S. Environmental Protection Agency ("EPA") has taken the important step of proposing much needed reforms to the RIN (or renewable identification number) market under the Renewable Fuel Standard ("RFS") program.[1] As a former senior market regulator at the Commodity Futures Trading Commission ("CFTC") and senior derivatives adviser at the Securities and Exchange Commission ("SEC"),[2] I offer the following comments in an effort to ensure that EPA considers fully evidence in the rulemaking record of problems in the RIN market, including high volatility, illiquidity, high and volatile transaction costs, irrational negative time value pricing relationships, rapid D6/D4 price convergence, and lack of public data. These issues collectively have been verified as problematic by biofuels producer, refiners, and academic commentators. I offer these remarks today as a consultant to Valero Services, Inc.

NERA Economic Consulting ("NERA"), pursuant to a request by Valero Services, Inc., studied D6 ethanol RIN market quality and issued the attached report, "Ethanol RIN Market Analysis and Potential Reforms" in October 2018 (hereinafter, "NERA Report"). The NERA Report is the most comprehensive, in-depth study of the D6 ethanol RIN market ever undertaken, to my knowledge. NERA used publicly available data from the EPA and price data vendors in the RIN market, statistical models, and background interviews to assess RIN market quality. NERA's analysis measured D6 ethanol RIN market quality against multiple recognized indicators of market quality, including price stability, liquidity, transaction costs, price discovery, and market integrity. This analysis identified significant market inefficiencies and potential for anticompetitive behavior in the RIN market. Specifically, NERA found that RINs:

- generally are five to ten times more volatile than similar energy commodities such as oil, ethanol, and natural gas futures,
- generally are only about one tenth as liquid as comparable commodity futures,
- have estimated transaction costs that peak five times higher than oil, ethanol, and natural gas futures,

[1] "Modifications to Fuel Regulations to Provide Flexibility for E15; Modifications to RFS RIN Market Regulations," 84 Fed. Reg. 10584, 10608 (March 21, 2019).
[2] I served as Chief Counsel and Deputy Director of the CFTC's Division of Trading and Markets from 1988 to 1997, and as a Senior Derivatives Adviser and Attorney Fellow at the SEC from 2009 to 2011. I have also been a partner at Dechert LLP and Davis Polk & Wardwell LLP.

- frequently transact at inefficient prices that defy rational expectations, and
- have a steeply tiered supply curve and a highly inelastic demand curve, creating the potential for substantial price increases in response to large speculative positions or hoarding.[3]

NERA concludes that "[t]hese market shortcomings compromise market integrity," "could create incentives to engage in hoarding" and "result[ ] in an inefficient and fragmented market."[4] A lack of public market data heightens the risks of these market shortcomings.[5] In any event, this observed behavior can hardly be described as an intended feature of a compliance program predicated on sustained RINs trading at predictable lower prices.

In light of the EPA's objective of "ensuring that the RIN market works efficiently and is free of anti-competitive behavior,"[6] NERA's data and analysis speak directly to EPA's proposed market reform initiatives, providing strong evidence that major reforms are needed.

I summarize below key aspects of NERA's analysis and address contentions made by the American Petroleum Institute in opposition to significant RIN market reforms.[7]

1. NERA's Assessment of RIN Market Quality.

Price Volatility. NERA compared RIN price volatility to that of comparable energy markets, such as oil futures, ethanol futures, and natural gas futures. This data revealed that RIN prices have demonstrated dramatic price increases and fluctuations since RFS2 was implemented, pricing around \$0.04 in 2012, rising to \$1.40 in 2013 and ranging between \$0.02 and \$1.10 since then.[8] Average lifetime volatilities for RINs were approximately six times higher than the same-expiry oil, ethanol, and natural gas futures, reaching twelve times the volatility of comparable energy futures for some vintages.[9] NERA also calculated the 30-day rolling volatility for all RIN vintages as well as for comparable futures The 30-day data reflects excess RIN price volatility in recent vintages, including frequent spikes in 30-day RIN price volatility during the 2017 and 2018 RIN vintages, even when comparable energy product price volatility was low.[10]

Illiquidity. To evaluate the liquidity of the RIN market, NERA compared RIN market turnover (the ratio of transaction volume to outstanding supply) to the turnover of comparable energy futures markets (the ratio of trade volume to open interest).[11] NERA found that the

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[3] NERA Econ. Consulting, *Ethanol RIN Market Analysis and Potential Reforms,* Prepared for Valero Services, Inc. at i, 32 (Oct. 18, 2018) (included as Attachment 1 to these comments).
[4] *Id.* at 36.
[5] *Id.*
[6] 84 Fed. Reg. at 10608.
[7] *See* Covington & Burling, White Paper, *An Analysis of the Renewable Fuel Standard's RIN Market* (Feb. 15, 2019), EPA-HQ-OAR-2018-0775-0004.
[8] NERA Report at i, 8.
[9] *Id.* at 8.
[10] *Id.* at 8-9.
[11] *Id.* at 11.

separated D6 RIN market is less liquid than comparable energy futures markets.[12] NERA also found that the separated D6 RIN market does not reflect increasing liquidity in months approaching vintage expiry, unlike energy futures, where liquidity consistently increases as expiration approaches, as contract holders typically seek to trade prior to contract expiration.[13] Further, NERA presents data for the period between 2015 and 2018 reflecting that RIN turnover declines as compliance expiry approaches for that vintage.[14]

Transaction Costs. Transaction costs can be estimated by calculating approximate bid-ask spreads.[15] Currently available RIN data do not include observed or quoted bid-ask spreads, but effective spreads can be approximated using established statistical models.[16] Applying such a model, NERA found that RIN spreads regularly are subject to large spikes of up to five times higher than those in comparable energy markets.[17] This finding means that RIN market participants regularly face transaction costs five times greater than those faced by other energy market participants.[18]

Price Discovery, Market Fragmentation, and Potential Hoarding. Price discovery is the process by which asset prices are determined by the interaction of buyers and sellers based on the forces of supply and demand.[19] Market efficiency is often measured by the rapidity with which new information is assimilated into prices across the entire market.[20] Markets with superior market efficiency will tend to transmit price information throughout the market very quickly.[21]

NERA examined RIN market data to identify evidence of market frictions, inefficiencies or potential hoarding. It found evidence consistent with all three in the RIN market:

> All three major price sources in the RIN market (EPA, Argus, and OPIS) show that RIN markets violated a fundamental economic expectation over dozens of weeks by pricing RINs closer to expiration above RINs with longer useful lives.[22]

A RIN that can be used at the owner's discretion either this year or next year should always be priced at least as highly as an otherwise equivalent RIN that can only be used this year and expires worthless if not so used.

In hundreds of days across dozens of weeks for each price data source, RINs of a nearer expiry date are reported as worth more in the market than identical RINs of later vintage with

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[12] NERA Report at 11.
[13] *Id.*
[14] *Id.* at 12.
[15] *Id.* at 14.
[16] *Id.* at 14-15.
[17] NERA Report at 15.
[18] *Id.*
[19] *Id.* at 7.
[20] *Id.*
[21] *Id.*
[22] *Id.* at i.

more optionality.[23] These data indicate that the RIN market frequently produces economically inefficient prices and that these problems persist even in recent years.[24]

These inefficiencies may be caused by market fragmentation, hoarding, or both.[25] For example, if prior year RINs are withheld from the market but current year RINs are not, and different traders tend to trade each vintage, prior year prices might spike relative to current year RINs, despite the higher time value of current year RINs.[26]

Market Integrity and Potential Manipulation. Market integrity refers to the fairness of a market and its ability to provide market participants the opportunity to transact at prices free of uneconomic distortions.[27] Susceptibility to manipulation exists where market structures or dynamics can be used to pursue manipulative strategies.[28]

NERA's review indicates that the RIN demand curve is highly inelastic and the supply curve is inelastic or tiered, *i.e.*, likely to exhibit sudden upward discontinuities in price during a single compliance year.[29] NERA's review of D6 and D4 price data shows that these sudden price discontinuities occurred on multiple occasions.[30]

NERA's analysis of the EPA's publicly available RIN holdings data indicates that hoarding is a plausible explanation for these price effects. From 2013 through 2017 non-obligated parties typically held about 5%-10% of the available RINs across all eligible vintages.[31] Holdings by non-obligated parties increased dramatically in 2018 to approximately 80% of total supply.[32] The potential for concentrations of speculative positions to be withheld from the market, the significant constraints on RIN supply, and the inelasticity of RIN demand create susceptibility to market manipulation and other anticompetitive conduct in the RIN market.

Conclusion. NERA's analysis of D6 RIN market quality and dynamics identified multiple indicia of an inefficient, fragmented market, susceptible to manipulation and other breaches of market integrity, and creating undue cost to market participants. These circumstances strongly support the need for market reforms. The NERA Report identifies potential policy reforms to address these issues, including position limits, increased reporting, and RIN auction facilities to provide a source of centralized price discovery and liquidity.

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[23] NERA Report at 19 & 19 fig.12 (charting price differentials as described above from 2011 to 2018).
[24] *Id.* at 19.
[25] *Id.* at 20.
[26] *Id.*
[27] *Id.* at 7.
[28] *Id.*
[29] NERA Report at 22.
[30] *Id.* at 21-23.
[31] *Id.* at 24.
[32] *Id.* at 25.

2. American Petroleum Institute's Contentions in Opposition to Major Market Reforms

The American Petroleum Institute ("API") has issued a white paper, "An Analysis of the Renewable Fuel Standard's RIN Market"[33] in which it rejects all suggested reforms of the RIN market other than "incremental reforms consistent with relying on price signals to influence stakeholder behavior."[34] In support of this view, API makes two primary arguments, both contrary to the NERA Report: (i) that no evidence exists of RIN market manipulation; and (ii) that RIN market volatility is attributable to external causes, such as regulatory actions and news reports, rather than the behavior of market participants.[35]

Claim of No Evidence of Manipulation. As more fully discussed in the NERA Report, data concerning RIN market transactions is limited, but even on the basis of that data, significant and repeated pricing anomalies are evident, as well as substantial potential for manipulative behavior.

API seeks to circumvent these facts by transforming congressional testimony by CFTC Chairman Christopher Giancarlo that RIN market data is insufficient to determine whether manipulation occurred into an affirmative declaration that the evidence shows that no manipulation occurred.[36] In fact, Chairman Giancarlo testified that RIN market data "was both limited and not of sufficient quality" and "analyzing bad data, you don't necessarily get good results" to determine whether manipulation has occurred in the RIN market.[37] These statements by CFTC leadership are far from the clean bill of health claimed by API and in reality make the case for the very market reforms EPA proposes.

API also seeks to deflect the evidence presented by NERA of frequent instances of irrational RIN pricing, reflective of potential hoarding behavior. As discussed above, NERA identified hundreds of trading days on which the RIN market displayed economically irrational pricing of RINs expiring sooner at higher prices than RINs expiring later. API dismisses this pricing behavior as simply a form of commodity market "price inversion," a term that is used to describe an economically rational pricing of a commodity based on its supply/demand profile at a given time.[38] Price inversions in commodity markets typically occur when a current commodity shortage reverses the usual pattern of contracts for delivery at a later month having a higher price than current delivery contracts (reflecting the 'cost of carry' of the commodity into the future). The result is that current delivery contracts become more valuable than contracts with later delivery months. This commodity market phenomenon is entirely irrelevant to RINs, in which there is no "contract delivery month," there is only one use for a RIN, and there is only

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[33] Covington & Burling, White Paper, *An Analysis of the Renewable Fuel Standard's RIN Market* (Feb. 15, 2019), EPA-HQ-OAR-2018-0775-0004 (hereinafter, "API Report").
[34] API Report at 3.
[35] *Id.* at 2-3.
[36] *Id.* at 17 (citing J. Christopher Giancarlo, Chair., CFTC, Testimony before the U.S. Senate Comm. on Agriculture, Nutrition, and Forestry at 1:03:35 (Feb. 15, 2018), *available at* https://www.agriculture.senate.gov/hearings/state-of-the-cftc-examining-pending-rules-cryptocurrency-regulation-and-cross-border-agreements).
[37] *Id.* at 1:03:47; *see* also Chris Clayton, *EPA RIN Market Data Poor*, DTN Ag, https://www.dtnpf.com/agriculture/web/ag/news/business-inputs/article/2018/02/15/cftc-draw-conclusion-rin-market-epa-2 (Feb. 15, 2018 3:58 PM).
[38] API Report at 18.

one difference between RINs of different vintages—whether they were generated last year and thus must be used either for compliance this year or whether they were generated this year and can be used this year or next year. There is simply no rational reason for the soon-to-expire RINs to ever have a higher value than the otherwise-identical RINs that still have two years of potential compliance value. Such an occurrence would be akin to customers paying more for milk about to expire tomorrow than identical milk that doesn't expire for several weeks. NERA identified this inverted pricing on hundreds of trading days, demonstrating that the RIN market is not a well-functioning market. API provides no credible explanation of this significant pattern of aberrant pricing.

Claim of Extraneous, Non-Market-Related Causes of Volatility. API offers no evidence or analysis contradicting the finding that the RIN market has significantly higher volatility than that of similar energy commodities. However, it contends that two factors unrelated to proposed market reforms account for RIN market volatility: (1) the "blendwall" limit on the quantity of ethanol that can be blended into the gasoline fuel supply; and (2) uncertainty surrounding EPA's setting of each year's fuel obligations and other regulatory events.[39] However, as discussed above, the NERA Report is the most comprehensive analysis of RIN market activity of which I am aware, and its findings demonstrate that RINs have exhibited exponentially higher volatility over comparable commodities, volatility that is consistent over the lifetime of each RIN vintage and over each 30-day rolling period.

API also claims that its benign explanation of RIN market volatility reflects a "consensus in the economic literature."[40] As discussed above, however, the NERA Report, the most comprehensive and granular analysis to date, does not accord with the supposed consensus. Moreover, it should be noted that the economic literature offered in support of the alleged consensus is far less definitive than API suggests. None of the cited sources reflects the full scope of data analyzed by NERA. Many concede that publicly available data are insufficient to draw definitive conclusions.[41]

API Mischaracterizes NERA's Position Limits Proposal. API mischaracterizes the position limits proposal described by NERA. NERA described position limits based on compliance and legitimate hedging needs (the current year's renewable volume obligation plus 20% of the forecast renewable volume obligation for the following year).[42] The existing 20% limit on the use of prior year RINs to meet current year compliance requirements means that RINs carried over beyond 20% of the next year's RVO *cannot* be used for that entity's compliance.[43] There is no legitimate hedging reason to hold RINs in excess of the current year's

[39] API Report at 2.
[40] *Id.*
[41] *See e.g.*, Written Testimony of Gabriel E. Lade Before the House Comm. On Energy & Comm., Subcomm. on Env't 10 (July 25, 2018) ("Publicly available RIN transaction data are insufficient to determine whether the market has been manipulated."), *available at* https://docs house.gov/meetings/IF/IF18/20180725/108610/HHRG-115-IF18-Wstate-LadeG-20180725.pdf; Scott Irwin, Dept. of Ag. & Consumer Econ., University of Illinois at Urbana-Champaign, "What's Up with RIN Prices?, Farmdoc daily, Vol. 6:188 (Oct. 5, 2016), *available at* https://farmdocdaily.illinois.edu/2016/10/whats-up-with-rins-prices html ("one cannot say with certainty that the RINs market has not been manipulated").
[42] NERA Report at 34-35.
[43] *Id.* at 35.

RVO plus 20% of next year's RVO at any time. This demonstrates the falsehood of API's claim that such excess RINs could be held "to maintain a compliance margin."[44]

API's Claimed Harms from Position Limits Suggest Market Prices Are High Due to Withheld Supply. API states that if entities holding such excess RINs were to make those RINs available for sale in the open market, it would "likely" result in such RINs being sold "at a discount."[45] If such sales occurred at a lower value than prevailing market prices, it suggests that market prices are high due to withheld supply.

The NERA report provides a comprehensive basis to conclude that trading patterns in the RINs market reflect dysfunction and inadequate market oversight and regulation. Based upon my substantial experience at the CFTC and the SEC dealing with regulation of trading and markets, the market reforms proposed by EPA for the RINs market represent a good first step in addressing persistent market flaws based on a reasonable interpretation of the available data. By contrast, critiques offered by interested parties holding long RINs positions seem to be predicated on fundamental mischaracterization of the RINs market and its operations.

Please feel free to contact me at (202)436-0066 if you have any questions concerning this letter.

Sincerely,

Susan Ervin/BMP

Susan Ervin

Attachment

[44] API Report at 31.

[45] *Id.* at 32.

Attachment 1:

NERA Econ. Consulting, *Ethanol RIN Market Analysis and Potential Reforms,* Prepared for Valero Services, Inc. (Oct. 18, 2018)

NERA
ECONOMIC CONSULTING

Ethanol RIN Market Analysis and Potential Reforms

Prepared for Valero Services, Inc.

18 October 2018

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Executive Summary

NERA analyzed D6 ethanol Renewable Identification Number ("RIN") market quality and dynamics under the current Renewable Fuel Standard ("RFS2") and identified significant problems including high volatility, illiquidity, high transaction costs, and inefficient market outcomes. For example, NERA found that RINs (1) are generally five to ten times more volatile than similar energy commodities like oil, ethanol, and natural gas futures, (2) are generally only about one tenth as liquid as comparable commodity futures, (3) have estimated economic transaction costs that peak five times higher than oil, ethanol, and natural gas futures, and (4) frequently transact at prices that defy rational pricing expectations. These problems harm RIN market quality, resulting in an inefficient market that is fragmented and creates incentives to engage in hoarding. The RIN market has seen dramatic increases and fluctuations in prices over the years since RFS2 was implemented, such as by steadily hovering around $0.04 in 2012, rapidly rising to $1.40 in 2013, and fluctuating between about $0.20 and $1.10 since then. These price spikes and fluctuations are not seen in comparable energy markets, and indicate the need for market reform. After analyzing these problems in detail, this study develops potential policy reforms to alleviate the identified problems, analogous to those that other regulators have used effectively to foster better-functioning markets.

RINs resemble and are closely related to paradigmatic energy commodities like biofuels and refined petroleum products. A RIN is generated whenever a biofuel is blended, tying RIN supply to the supply of an energy commodity, and demand is determined by regulatory mandates set proportionately to traditional fuel refining activity. RIN markets are distinct from energy commodity markets in that the only commercial end use for RINs is demonstrating regulatory compliance. Specifically, obligated entities must submit RINs to the Environmental Protection Agency ("EPA") to demonstrate compliance with Renewable Volume Obligation ("RVO") requirements, and there is no alternative commercial purpose to which RINs can serve as an input. This suggests that it is even more important for EPA to reform the RIN market to promote more efficient market behavior that rests on legitimate forces of supply and demand to more closely align the pricing of RINs with their sole purpose of compliance.

NERA analyzed RIN market data to determine whether there is evidence of market frictions, inefficiencies, or potential hoarding, and found evidence consistent with all three being present in the market. All three major price sources in the RIN market (EPA, Argus, and OPIS) show that RIN markets violated a fundamental economic expectation over dozens of weeks by pricing RINs closer to expiration above RINs with longer useful lives. This outcome is an inefficient result (referred to as negative time value) akin to choosing between otherwise identical flight vouchers from the same airline with different expiration dates and paying more for the voucher with less time until expiration. If both vouchers offer identical flight benefits, but one expires this year and the other expires one year later, rational consumers should never prefer the voucher with the shorter life, and will pay less for vouchers with less time remaining. The option with more time to expiration (known as optionality or time value) should be valued at least as highly as–and typically higher than–the option closer to expiration. Where a market assigns negative time value to additional time to expiry, such as by producing higher prices for assets closer to expiration, that indicates market inefficiencies. These inefficiencies may result from market fragmentation, hoarding, or both.

NERA's analysis of the supply curve fundamentals and observed price changes in the RIN market is consistent with a supply curve step function such that small amounts of hoarding could shift the supply curve leftward enough to cause prices to jump up to much higher levels, creating a potential incentive for longs[1] in the market to withhold supply. This too harms the natural forces of supply and demand that are the bedrock of a well-functioning market.

NERA also found limited availability of historical price data in the RIN market. Proprietary data vendors Argus and OPIS act as the primary sources of daily price data for market participants, but each relies on voluntary data reporting by distinct (and not necessarily exactly overlapping) groups as the basis for their respective price reports. The limited availability of daily price data, and the existence of non-trivial daily price differences between the two primary sources, could slow price discovery in the RIN market. Moreover, based on a comparative analysis of data collected by the EPA against data collected by supervisory authorities in similar markets, it appears that the EPA has insight only into physical positions (transfers of title) in the market. This is a potentially significant shortcoming in the EPA's data reporting regime due to the presence of a substantial derivatives market, particularly in forward transactions. Absent data collection on forward transactions, the EPA may not have an accurate view of available supply in the RIN market, and may be unable to detect hoarding or attempted manipulation.

There are several policy reforms that would help alleviate these observed market problems. The EPA would benefit from a position data reporting regime modeled on the Commodity Futures Trading Commission ("CFTC")'s Large Trader Reporting Program that covers both physical and derivative positions. Such a data reporting regime would facilitate RIN market oversight with respect to market integrity, market quality, and price discovery, and ensure that the EPA could ascertain deliverable supply of RINs in the market.

Another reform that would help alleviate RIN market quality problems would be the establishment of position limits set proportional to entities' RVOs. Due to the absence of hedging or end uses for RINs besides demonstrating compliance with RVOs, position limits proportional to RVOs would increase liquidity by pushing entities that generate RINs far in excess of their RVOs to make those RINs available to the market, and to do so in a more timely manner. This would have the added benefit of impeding any potential manipulation attempts via hoarding. This would also follow longstanding precedent in other energy commodity markets, such as those regulated by the CFTC, and would follow the EPA's own precedent in establishing effective limits on carryover RINs.

An additional reform that could help alleviate RIN market quality issues would be the creation of a periodic RIN auction facility to provide a regular source of centralized price discovery and liquidity. Such auctions have established precedents in emissions cap-and-trade markets and renewable energy certificate markets, and would provide for centralized price discovery across different vintages of RINs and reduce transaction costs and search costs around each auction. Potential mechanisms for such an auction are discussed below.

[1] Note that this study refers to "shorts" as obligated parties that lack sufficient RIN origination capabilities to satisfy their yearly RVO, whereas "longs" are obligated parties, RIN originators, or other market participants that produce an excess supply of RINs relative to their RVO (which is zero for non-obligated parties).

1. Introduction

Valero Services, Inc. ("Valero") asked NERA to analyze D6 ethanol RIN market quality and dynamics, identify any problems in the current market, and develop potential policy reforms to alleviate the identified problems.[2] NERA relied upon publicly available information, such as data from the EPA,[3] as well as price and volume data from the data vendors Argus and OPIS in the RIN market and Bloomberg, LP in energy commodity markets. NERA also utilized discussions with traders and other market participants to help NERA contextualize the analysis and elucidate the issues that entities that are naturally short RINs face in the RIN market.

This white paper begins with a description of the RIN market, from its regulatory origins to current market design and market practice, followed by a description of factors useful in assessing financial market quality. Next, this paper explores the analyses NERA conducted to assess RIN market quality and identify current problems in the RIN market. Following the analyses, this white paper suggests potential policy solutions to the identified problems and explains how those solutions would improve market quality.

2. RIN Market Background

2.1. RINs as Renewable Fuel Standard Compliance Tools

The enactment of the Energy Policy Act of 2005 created the first Renewable Fuel Standard ("RFS") in the United States to increase biofuels blending.[4] The RFS was substantially updated by the Energy Independence and Security Act of 2007, leading the current RFS to be commonly referred to as "RFS2."[5]

RFS2 calls for biofuel blending to be demonstrated using RINs, unique strings of numbers that are generated by biofuel producers and importers when biofuel is created or imported and recorded within the EPA Moderated Transaction System ("EMTS").[6] The RINs are initially assigned to the batch of biofuel they were generated with, and cannot be transacted independently of that fuel.[7] Once biofuels have met certain requirements, such as being blended with traditional fuels like gasoline or diesel, assigned RINs can be separated from the biofuel batch to which they were assigned, and can be recorded within EMTS

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[2] NERA would like to thank Stacie R. Hartman of Schiff Hardin LLP for her assistance in connection with this engagement.

[3] NERA would like to express its gratitude to the EPA's Fuels Program Support staff, who were responsive and helpful when NERA asked about data available on the EPA website. In particular, NERA is grateful for the September 20, 2018 EPA website data update following NERA's data requests, which allowed NERA to analyze the RIN market using the most recent data.

[4] See *Renewable Fuel Standard (RFS): Overview and Issues*, Randy Schnepf and Brent D. Yacobucci, Congressional Research Service, October 14, 2010, p. 1.

[5] See *Renewable Fuel Standard (RFS): Overview and Issues*, Randy Schnepf and Brent D. Yacobucci, Congressional Research Service, October 14, 2010, pp. 1-2.

[6] See *The Renewable Fuel Standard (RFS): An Overview*, Kelsi Bracmort, Congressional Research Service, July 31, 2018, pp. 3-4.

[7] See "Renewable Identification Numbers (RINs) under the Renewable Fuel Standard Program," EPA, available at https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-numbers-rins-under-renewable-fuel-standard.

as separated RINs.[8] Separated RINs can be traded independently of the underlying biofuel.[9] These separated RINs can be used by obligated parties to meet their RVO for the current compliance year or the subsequent compliance year, giving RINs a maximum of a two-year shelf life for practical purposes.[10]

The RVO for each obligated party is determined by the product of an obligated party's total volumes of traditional fuels produced or imported with an EPA-mandated number representing the required percentage of biofuel penetration for that compliance year.[11] An obligated party submits RINs meeting its RVO to the EPA within EMTS to demonstrate compliance with RFS2.[12] If an obligated party fails to meet its RVO for one compliance year, there is a limited, conditional option to carry over the compliance deficit to the subsequent year, providing a modest amount of compliance flexibility.[13] In addition, if an entity holds RINs in excess of its RVO compliance needs, it can carry over these RINs to the subsequent compliance year, subject to the limitation that no entity may satisfy more than 20% of its RVO for a given year with RINs generated in the prior compliance year.[14]

RFS2 creates a nested categorization of biofuels that allows for unidirectional substitution of RINs for RVO compliance purposes.[15] The four major biofuel categories, cellulosic biofuel, biomass-based diesel ("BBD"), advanced biofuel, and total renewable fuel (which includes ethanol, the most common renewable fuel) are nested such that distinct RVOs and RINs exist for each category, and RINs from higher, more specific categories can be used to satisfy RVOs from lower, more general categories but not vice-versa.[16] Consequently, cellulosic biofuel and BBD RINs can satisfy any RVO, advanced biofuel RINs can satisfy advanced biofuel RVOs or total renewable fuel RVOs, and ethanol RINs can satisfy only total renewable fuel RVOs.[17] Due to different energy densities of different biofuels, different biofuels can generate different numbers of RINs per gallon of biofuel produced or imported. However, for compliance purposes, and subject to the unidirectional nested RVO mandate structure, one RIN of a more specific

[8] See "Renewable Identification Numbers (RINs) under the Renewable Fuel Standard Program," EPA, available at https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-numbers-rins-under-renewable-fuel-standard.

[9] See "Renewable Identification Numbers (RINs) under the Renewable Fuel Standard Program," EPA, available at https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-numbers-rins-under-renewable-fuel-standard.

[10] See "Renewable Identification Numbers (RINs) under the Renewable Fuel Standard Program," EPA, available at https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-numbers-rins-under-renewable-fuel-standard.

[11] See *The Renewable Fuel Standard (RFS): An Overview*, Kelsi Bracmort, Congressional Research Service, July 31, 2018, pp. 3-4.

[12] See *The Renewable Fuel Standard (RFS): An Overview*, Kelsi Bracmort, Congressional Research Service, July 31, 2018, pp. 3-4.

[13] See *The Renewable Fuel Standard (RFS): An Overview*, Kelsi Bracmort, Congressional Research Service, July 31, 2018, p. 4.

[14] See *The Renewable Fuel Standard (RFS): An Overview*, Kelsi Bracmort, Congressional Research Service, July 31, 2018, p. 4.

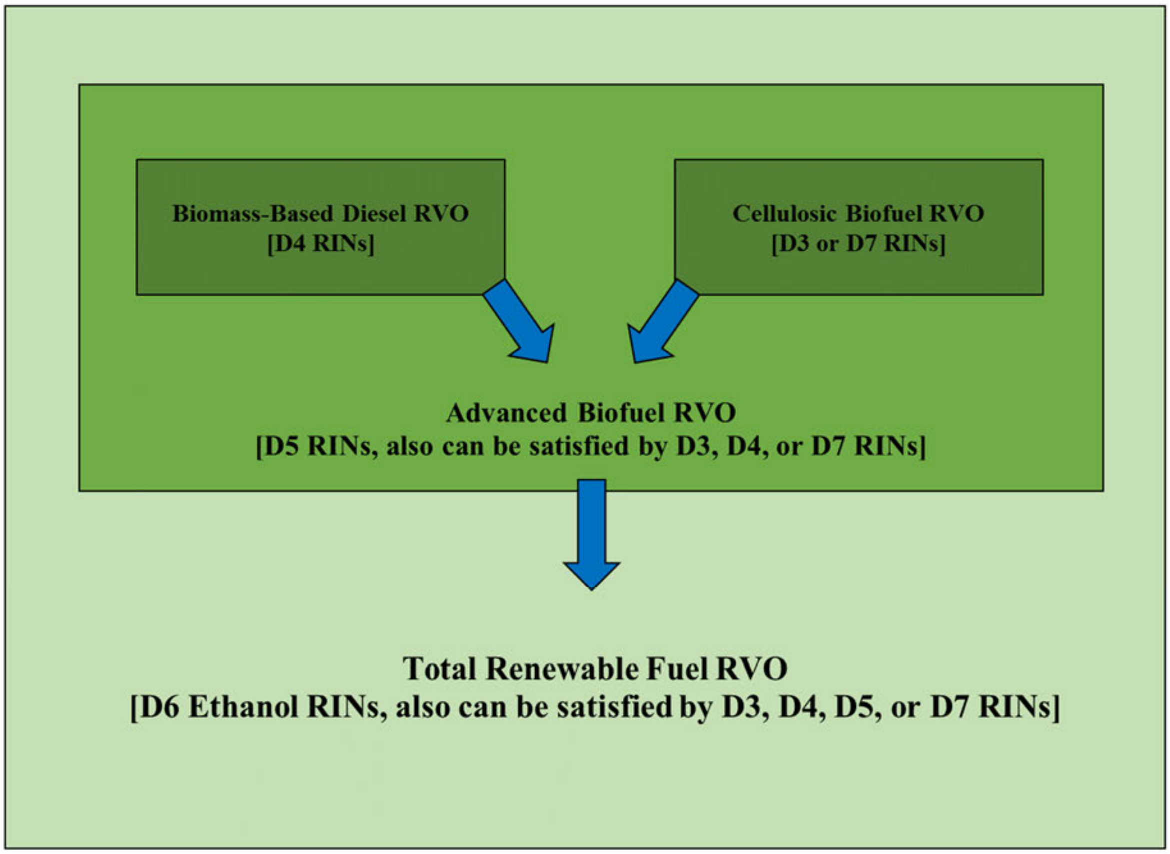
[15] See "Overview for Renewable Fuel Standard," EPA, available at https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard.

[16] See "Overview for Renewable Fuel Standard," EPA, available at https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard; *Renewable Fuel Standard (RFS): Overview and Issues*, Randy Schnepf and Brent D. Yacobucci, Congressional Research Service, October 14, 2010, p. 5.

[17] Note that the total renewable fuels RVO is the only category that can be satisfied using D6 ethanol RINs, the most common type of RIN and the primary subject focus of this white paper. See *Renewable Fuel Standard (RFS): Overview and Issues*, Randy Schnepf and Brent D. Yacobucci, Congressional Research Service, October 14, 2010, p. 5.

category can perfectly substitute for one RIN of a more general category to meet a more general category's RVO.[18] The nested RIN mandates are illustrated below in Figure 1.

Figure 1
Illustration of Nested RIN Mandates in RFS2



2.2. RIN Market Design and Structure

EMTS is used to record RIN generation, separation, title, and retirement, whether for compliance purposes or otherwise.[19] Transactions in separated RINs are recorded in EMTS within five days of a transfer of title, but transactions are not negotiated or executed within EMTS; transactions are only

[18] See *The Renewable Fuel Standard (RFS): An Overview*, Kelsi Bracmort, Congressional Research Service, July 31, 2018, p. 5; *Renewable Fuel Standard (RFS): Overview and Issues*, Randy Schnepf and Brent D. Yacobucci, Congressional Research Service, October 14, 2010, p. 5.

[19] See "How to Use EMTS to Report Transactions for Fuel Programs," EPA, available at https://www.epa.gov/fuels-registration-reporting-and-compliance-help/how-use-emts-report-transactions-fuel-programs.

recorded there following delivery.[20] The separated RIN market—the segment of the RIN market most relevant for the analysis in this white paper—is structured as an OTC market with voice-brokers and electronic chats as primary channels of negotiation and trade execution.[21] Both spot and forward transactions in RINs are common, with the potential for options, swaps, and other OTC derivative transactions as well.

RINs' two-year expiration cycles, ultimate end use via delivery to the EPA, and the simultaneous existence of multiple RIN vintages collectively resemble physically-settled commodity futures, multiple tenors of which are traded simultaneously. RINs appear to meet the definition of a "commodity" in the Commodity Exchange Act: "all other goods and articles […] and all services rights and interests […] in which contracts for future delivery are presently or in the future dealt in."[22] RIN futures are listed on several exchanges,[23] and data vendors publish information about the RIN market alongside and in the same format as other energy commodities like biofuels within the same reports.[24] RINs also are generated within EMTS alongside paradigmatic energy commodities such as biofuels. They are used to demonstrate RVO regulatory requirements proportional to the generation of refined fossil fuels, which also are paradigmatic energy commodities. The energy commodity origins and nature of RINs and the OTC commodity market design and structure of the RIN market suggest that analysis of the RIN market can and should follow the well-established approaches used by the CFTC, academics, and commodity market participants to analyze commodity markets. The distinctive features of the RIN market that set it apart from commodity markets reflect its origins in regulatory mandates and status as a regulatory compliance instrument—for example, the demand curve for practical purposes can be considered a fixed value set by the EPA when the EPA announces blending percentage standards used to calculate RVOs for a given compliance year.[25] Unless RIN prices become substantially higher than their highest ever peak prices, refiners are unlikely to adjust their traditional fuel production or imports in response to RIN prices, allowing the RIN demand curve to be modeled as a perfectly inelastic vertical line.

One regulatory market design feature, the RFS2 nested mandate structures allowing for unidirectional substitution of RINs, [26] mimics futures markets' cheapest-to-deliver concept, whereby multiple grades of

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[20] See "Reporting RFS RIN Transactions in the EPA Moderated Transaction System," EPA, available at https://www.epa.gov/fuels-registration-reporting-and-compliance-help/reporting-rfs-rin-transactions-epa-moderated.

[21] Argus and OPIS are two such brokerages from which RIN pricing data are analyzed in this study. See *OPIS Renewable Fuels/RIN Credits*, OPIS, available at https://www.opisnet.com/wp-content/uploads/2018/03/OPIS-RenewableFuels-RINCredits.pdf. See also *Argus Americas Biofuels*, RINs (Renewable Identification Numbers) p. 8, Argus, available at https://www.argusmedia.com/-/media/Files/methodology/argus-americas-biofuels.ashx.

[22] 7 U.S.C. § 1a(9).

[23] InterContinental Exchange, "Gasoline Outright – D6 RINs (OPIS) Current Year Future," available at https://www.theice.com/products/68361253/Gasoline-Outright-D6-RINs-OPIS-Current-Year-Future; CME Group, "Trade Biofuel Products," available at https://www.cmegroup.com/trading/agricultural/biofuel html.

[24] Argus Media, "Argus Biofuels: Daily international market prices and commentary," January 31, 2018, available at https://www.argusmedia.com/-/media/Files/sample-reports/argus-biofuels.ashx?la=en&hash=722281F6D0DD05BC0145352940C5E57E1A6A020E; OPIS, "Ethanol & Biodiesel Information Service," December 11, 2017, available at https://www.opisnet.com/wp-content/uploads/2017/12/EBISnewsletter-sample.pdf.

[25] See *Ethanol RIN Waiver Credits: Improving Outcomes of the Renewable Fuels Standard through a Price Containment Mechanism*, pp. 5-6, Charles River Associates, available at http://www fuelingusjobs.com/library/public/CRA_RIN_PriceContainment_March_2018.pdf.

[26] See *Analysis of Renewable Identification Numbers (RINs) in the Renewable Fuel Standard (RFS)*, pp. 1-2, Congressional Research Service, available at http://nationalaglawcenter.org/wp-content/uploads/assets/crs/R42824.pdf.

a commodity can be used to meet delivery obligations and rational market participants choose to deliver the cheapest grade.[27] For example, D6 ethanol RINs can be used to satisfy only the total renewable fuels RVO, but D4 BBD RINs can satisfy multiple RVOs, including both the BBD RVO and the total renewable fuels RVO. Since D4 RINs are more flexible than D6 RINs and can be used just as effectively to meet the total renewable fuel RVO, D4 RINs should always be at least as expensive as D6 RINs in an efficient market.

Another regulatory market design feature is the combination of a two-year RIN expiry cycle with a 20% RIN carryover limit. RINs may be used only in the compliance year they were produced or the subsequent compliance year, and no entity may use more than 20% prior year RINs to satisfy its current RVO.[28] The carryover limit as currently structured constrains obligated parties with respect to how they meet their RVOs, and effectively constrains only natural shorts in the market.[29] There is no limit on how many RINs an individual entity may carry over or how large of a position any individual entity may hold at a given time, which can allow individual natural long entities, such as RIN originators with relatively small RVOs, to withhold supply from the market at their discretion. The 20% cap on prior year RINs for current year compliance theoretically could limit the market as a whole to 20% aggregate RIN carryover, as aggregate carryover beyond 20% of the subsequent year's RVO would result in some quantity of unusable and unsaleable RINs, but the market has not come close to exceeding the 20% aggregate carryover threshold in recent years.[30] Consequently, individual natural long entities can carry over RINs well in excess of 20% of their subsequent-year RVOs. Thus, carryover limits act as a constraint on hedging by individual obligated entities but not on originators. Carryover limits are analyzed in relation to and contrasted with similar but distinct position limits later in this white paper.

2.3. Market Quality Factors

Market quality can be determined by assessing common indicators like price stability, liquidity, transaction costs, price discovery, and market integrity. Relevant indicia of a well-functioning market according to these factors are explained in more detail below.

2.3.1. Price Stability

Price stability is commonly evaluated by examining the volatility of a market. A more volatile market has less price stability than a less volatile market, and volatility is associated with conditions such as illiquidity, high transaction costs, market fragmentation, or manipulation.[31] Volatile markets create

[27] The principles of cheapest-to-deliver use are most often applied in the bond futures market, whereby several classes of bonds are considered deliverable to satisfy a futures contract. See *Cheapest-to-Deliver*, CFTC Glossary, available at https://www.cftc.gov/ConsumerProtection/EducationCenter/CFTCGlossary/glossary_c html.

[28] See 40 CFR 80.1127.

[29] 40 CFR 80.1127 applies only to obligated parties. There is no specification or limit to how many RINs a non-obligated party can hold past the first compliance year for a given vintage RIN.

[30] The EPA reports the annual total volume of carryover RINs as a percent of total proposed RVO, and this figure has been below 20 percent in recent years. See 83 FR 32030, 82 FR 58494.

[31] Mittnik, Stefan, Nikolay Robinzonov, and Martin Spindler. "Stock market volatility: Identifying major drivers and the nature of their impact." *Journal of Banking and Finance*, Vol. 58 (Sep., 2015), pp. 1-14; Hau, Harald. "The Role of Transaction Costs

substantial uncertainty for commercial market participants like hedgers and end users, as volatility makes supply and storage/inventory decisions more difficult. The CFTC has concluded that volatility tends to harm end users, particularly in fragmented markets.[32] By contrast, certain strategies executed by speculators benefit from increased volatility.

2.3.2. Liquidity

Liquidity can be defined in several ways, but one useful definition comes from the CFTC, whose Chairman J. Christopher Giancarlo in November 2017 defined liquidity as "the degree to which financial assets may be easily bought or sold with minimal price impact by ready and willing buyers and sellers."[33] In other words, in a well-functioning market, one expects sizable trades to occur routinely with minimal price impact. Potential indicia of liquid markets include lower transaction costs (such as narrower bid-ask spreads), higher trading volume, and higher turnover (the ratio of financial contracts traded to total financial contracts outstanding) than less liquid markets. [34]

2.3.3. Transaction Costs

Transaction costs are the costs a buyer or seller incurs as part of engaging in a transaction. These costs represent a potential friction inhibiting efficient price discovery (which is defined in the next section below), since higher transaction costs would be expected to interfere with the ability to execute an arbitrage trade (e.g., trades that are based on price differences in the market, and that serve to enhance market efficiency). As a result, market quality is often evaluated in part by estimating transaction costs, with lower transaction costs generally indicating higher market quality.[35] Transaction costs are often evaluated by estimating effective bid-ask spreads, where such spreads represent the economic transaction

for Financial Volatility: Evidence from the Paris Bourse," *Journal of the European Economic Association*, Vol. 4, No. 4 (Jun., 2006), pp.862-890; O'Hara, Maureen and Mao Ye. "Is Market Fragmentation Harming Market Quality?" *Journal of Financial Economics*, Vol. 100, No. 3 (Jun., 2011), pp. 459-574; Uppal, Jamshed Y. and Inayat U. Mangla. "Regulatory Response to Market Volatility and Manipulation: A Case Study of Mumbai and Karachi Stock Exchanges," *The Lahore Journal of Economics*, Vol. 11, No. 2, (Winter 2006), pp. 79-105.

[32] See, for example, Chairman Christopher J. Giancarlo, "Remarks by Chairman Christopher J. Giancarlo at the ISDA Industry and Regulators Forum, Singapore," Commodity Futures Trading Commission, September 12, 2018, available at https://www.cftc.gov/PressRoom/SpeechesTestimony/opagiancarlo55.

[33] Chairman J. Christopher Giancarlo, "Remarks of Chairman J. Christopher Giancarlo to the Federal Reserve Board of New York Third Annual Conference on the Evolving Structure of the U.S. Treasury Market," Commodity Futures Trading Commission, November 28, 2017, available at https://www.cftc.gov/PressRoom/SpeechesTestimony/opagiancarlo-33#P39_8193.

[34] Chairman J. Christopher Giancarlo, "Remarks of Chairman J. Christopher Giancarlo to the Federal Reserve Board of New York Third Annual Conference on the Evolving Structure of the U.S. Treasury Market," Commodity Futures Trading Commission, November 28, 2017, available at https://www.cftc.gov/PressRoom/SpeechesTestimony/opagiancarlo-33#P39_8193.

[35] See, for example, Bessembinder, Hendrik. "Trade execution costs and market quality after decimalization." *Journal of Financial and Quantitative Analysis* 38.4 (2003): 747-777, available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.854.9865&rep=rep1&type=pdf.

cost associated with buying closer to the ask price or selling closer to the bid price.[36] The financial economics literature has developed widely-cited approaches to estimate effective bid-ask spreads when the observed bid-ask spread is not readily available.[37]

2.3.4. Price Discovery, Transparency, and Market Fragmentation

Price discovery is the process of determining the price level for an asset through the interaction of buyers and sellers based on natural market supply and demand.[38] Market efficiency is commonly evaluated with respect to how quickly price discovery incorporates new information into prices across an entire market,[39] such that markets with high quality price discovery tend to transmit price information to all corners of the market relatively quickly. Efficient markets tend to be relatively transparent, in that price changes are consistently visible to the entire market in relatively short order. Some markets, however, such as fragmented markets, may not transmit price signals to all corners of the market.[40] Market fragmentation could cause certain market segments to trade at lagging prices or independent prices for extended periods until an informed market participant arbitrages the price differentials between distinct market fragments to bring price discovery to those fragments.

2.3.5. Market Integrity and Susceptibility to Manipulation

Market integrity is a market quality factor that generally refers to whether a market is fair and allows market participants the ability to transact at prices free from uneconomic distortions.[41] Susceptibility to manipulation generally can be defined in this context as the degree to which, and frequency with which, market structures or microstructures could allow for profitable manipulation strategies such that there may exist incentives to manipulate a given market.[42] Meaningful ways to evaluate susceptibility to

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[36] Roll, Richard. “A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market.” *The Journal of Finance*, Vol. 39, No. 4. 9 (Sep. 1984), pp. 1127-1139.

[37] Roll, Richard. “A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market.” *The Journal of Finance*, Vol. 39, No. 4. 9 (Sep. 1984), pp. 1127-1139.

[38] Commodity Futures Trading Commission, “CFTC Glossary,” available at https://www.cftc.gov/ConsumerProtection/EducationCenter/CFTCGlossary/glossary_p html.

[39] See, for example, Chordia, Tarun, Richard Roll, and Avanidhar Subrahmanyam. “Liquidity and market efficiency.” Journal of Financial Economics 87.2 (2008): 249-268 at Abstract, available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.892.7580&rep=rep1&type=pdf.

[40] Commissioner Luis A. Aguilar. “U.S. Equity Market Structure: Making Our Markets Work Better for Investors.” *U.S. Securities and Exchange Commission.* May 11, 2015, available at https://www.sec.gov/news/statement/us-equity-market-structure html.

[41] World Federation of Exchanges and Oliver Wyman. “Market infrastructures and market integrity: A post-crisis journey and a vision for the future,” p. 3, available at https://www.world-exchanges.org/home/index.php/files/18/Studies---Reports/499/WFE---Oliver-Wyman-Market-Integrity-report.pdf; NASDAQ OMX, “Measuring Market Quality,” available at http://www nasdaqomx.com/digitalAssets/81/81039_frederickharris_marketquality.pdf.

[42] Technical Committee of the International Organization of Securities Commissions, “Investigating and Prosecuting Market Manipulation,” May 2000, available at https://www.iosco.org/library/pubdocs/pdf/IOSCOPD103.pdf.

manipulation include considering the regulatory market monitoring and enforcement regime as well as examining the relevant supply and demand curves.[43]

3. Analysis

3.1. Volatility

In order to evaluate the volatility of the RIN market, NERA analyzed daily RIN price data from Argus and OPIS and compared RIN price volatility to volatility observed in comparable energy markets, such as oil futures, ethanol futures, and natural gas futures. As reflected in Figure 2 below, NERA found that price volatility for D6 RINs is significantly higher than that of comparable energy markets, with average lifetime volatilities about six times higher than same-expiry oil, ethanol, and natural gas futures (e.g., compare 2018-vintage RINs (5.41 and 5.46 for Argus and OPIS data, respectively) to 2020-expiry ethanol futures (0.81 and 0.83, respectively)) and about three times higher than prompt month futures volatilities (e.g., compare 2017-vintage RINs (5.06 and 5.19 for Argus and OPIS data, respectively) to 2017 prompt month ethanol futures (1.37 and 1.36, respectively)), from the 2016 vintage onward. Over some vintages, lifetime D6 RIN volatility reached more than twelve times the volatility of comparable energy futures (e.g., compare 2018-vintage RINs (5.41 and 5.46 for Argus and OPIS data, respectively) to 2020-expiry natural gas futures (0.42 and 0.43, respectively)). This conclusion is prevalent across both 30-day rolling volatility measures as well as RIN lifetime volatility measures.

To calculate D6 RIN price volatility, NERA used price data from Argus and OPIS. These data sources report RIN prices by vintage on a daily basis. NERA calculated lifetime price volatility as the standard deviation of the daily rate of price changes over the entire date range of available price data. It should be noted that Argus and OPIS provide somewhat different date ranges of pricing data, and rely on reports from potentially different sources. Thus, NERA calculates lifetime volatility over the full date range available for each vintage and for each data source.

Using daily price data for comparable energy futures such as oil, ethanol, and natural gas, NERA also calculated lifetime volatilities of these contracts over both the Argus and OPIS lifetime for the comparable RIN vintage. Therefore, comparable futures price volatility (contracts with an expiry in April of the year that RIN vintage expires)[44] is calculated over this same date range.

NERA also calculated the 30-day rolling volatility for all RIN vintages and data sources, as well as for comparable futures. This volatility is calculated as the standard deviation of the daily rate of price changes, but restricted to the prior 30-days of price data.

[43] Technical Committee of the International Organization of Securities Commissions, "Investigating and Prosecuting Market Manipulation," May 2000, available at https://www.iosco.org/library/pubdocs/pdf/IOSCOPD103.pdf; World Federation of Exchanges and Oliver Wyman. "Market infrastructures and market integrity: A post-crisis journey and a vision for the future," p. 3, available at https://www.world-exchanges.org/home/index.php/files/18/Studies---Reports/499/WFE---Oliver-Wyman-Market-Integrity-report.pdf; NASDAQ OMX, "Measuring Market Quality," available at http://www nasdaqomx.com/digitalAssets/81/81039_frederickharris_marketquality.pdf.

[44] The compliance deadline for each compliance year is commonly the end of March of the subsequent calendar year. For example, the RFS 2017 Annual Compliance Deadline was March 31, 2018. Environmental Protection Agency, "RFS 2017 Annual Compliance Deadline," January 12, 2018, available at https://www.epa.gov/fuels-registration-reporting-and-compliance-help/enviroflash-announcements-about-epa-fuel-programs#compliance-deadline.

Figure 2
D6 RIN Lifetime Volatility Compared with Comparable Energy Commodity Volatility

	RIN Vintages, Year:						
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
ARGUS Lifetime Volatility[1]	5 31	5 86	4 29	4 28	4 82	5 06	5 41
OPIS Lifetime Volatility[1]	5 67	5 18	4 08	4 08	4 56	5 19	5 46
	Comparable Oil Futures, Expiring April of:						
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Volatility During ARGUS Lifetime of Comparable RIN[2]	1 19	0 99	1 74	1 94	1 57	1 26	0 99
Volatility During OPIS Lifetime of Comparable RIN[2]	1 19	1 36	1 87	1 92	1 57	1 20	1 01
	Comparable Ethanol Futures, Expiring April of:						
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Volatility During ARGUS Lifetime of Comparable RIN[2]	1 16	1 20	1 16	1 17	1 02	0 99	0 81
Volatility During OPIS Lifetime of Comparable RIN[2]	1 33	1 26	1 17	1 17	1 02	0 97	0 83
	Comparable Natural Gas Futures, Expiring April of:						
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Volatility During ARGUS Lifetime of Comparable RIN[2]	1 25	1 06	1 11	1 31	0 94	0 58	0 42
Volatility During OPIS Lifetime of Comparable RIN[2]	1 33	1 35	1 23	1 30	0 94	0 59	0 43
	Comparable Commodity Prompt Month Contracts During RIN Vintage Lifetimes:						
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Oil Volatility During ARGUS Lifetime[2]	1 62	1 30	2 32	2 84	2 33	1 83	1 52
Oil Volatility During OPIS Lifetime[2]	1 57	1 96	2 44	2 81	2 33	1 73	1 53
Ethanol Volatility During ARGUS Lifetime[2]	1 42	3 21	2 46	1 89	1 37	1 37	1 17
Ethanol Volatility During OPIS Lifetime[2]	2 61	2 59	2 59	1 91	1 37	1 36	1 18
Natural Gas Volatility During ARGUS Lifetime[2]	3 21	2 40	3 01	3 07	2 84	2 47	2 21
Natural Gas Volatility During OPIS Lifetime[2]	2 76	2 71	2 88	3 05	2 84	2 46	2 16

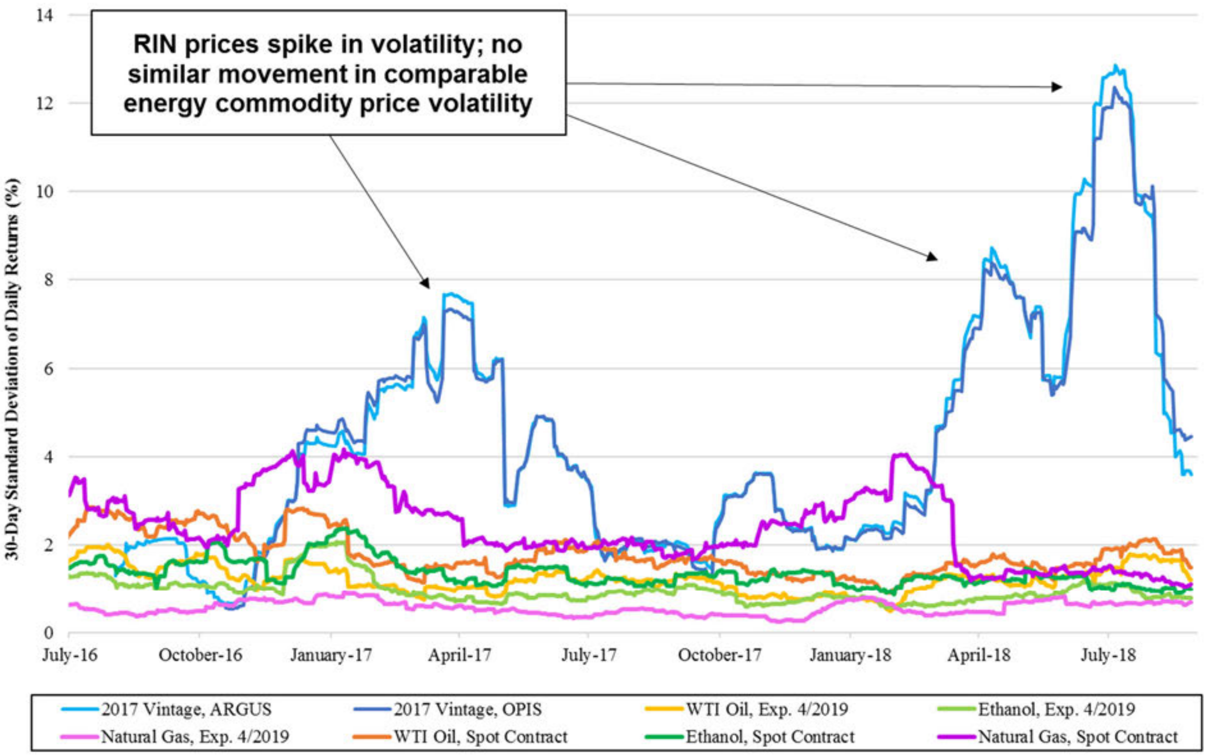
Notes & Sources: RIN Data from ARGUS and OPIS Commodity Spot and Futures Data from Bloomberg, L P

[1] Argus and OPIS provide RIN data for each vintage across different dates Volatility is calculated utilizing all dates available, as the standard deviation of the daily rate of change

[2] Comparable price volatility is calculated across the same date range for which RIN pricing is available through ARGUS and OPIS, respectively

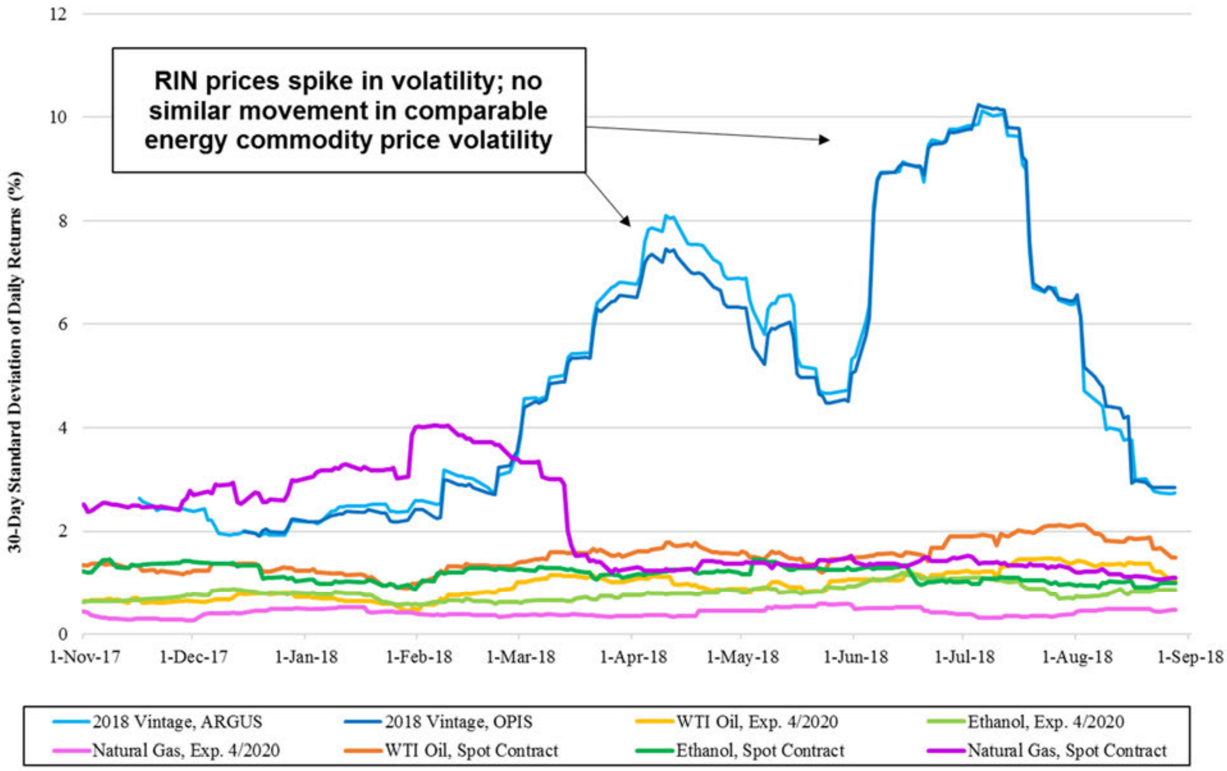
Figures 3 and 4 below show that excess RIN price volatility is observable in recent vintages. Spikes in 30-day RIN price volatility occurred frequently during the 2017 and 2018 RIN vintages, even at times when comparable energy product price volatility appears low and steady. For example, Figure 3 identifies spikes in volatility in RIN 2017 vintage prices such as occurred in April 2017 and April and July 2018; by contrast, the volatility of comparable energy trading in West Texas Intermediate ("WTI") oil, ethanol, and natural gas futures and spot contracts is relatively even across the same time periods and there are no volatility spikes. Figure 4 identifies a similar pattern of spikes in RIN 2018 vintage price volatility, which are not observed in comparable energy futures and spot trading.

Figure 3
30-day Rolling Average Volatility of Daily Returns[1] During the 2017 RIN Vintage



Notes & Sources:
[1] Volatility of Daily Returns is calculated as the standard deviation of the daily rate of change for the previous 30 trade dates.

Figure 4
30-day Rolling Average Volatility of Daily Returns[1] During the 2018 RIN Vintage



Notes & Sources:
[1] Volatility of Daily Returns is calculated as the standard deviation of the daily rate of change for the previous 30 trade dates.

3.2. Illiquidity

In order to evaluate RIN market liquidity, NERA compared RIN market turnover[45] to comparable energy commodity futures market turnover.[46] NERA found that the separated D6 RIN market is less liquid than comparable energy futures markets based on turnover data. The separated D6 RIN market also does not exhibit increasing liquidity in months approaching vintage expiry, as energy futures markets do as maturity approaches. It is expected that liquidity will increase as expiration approaches because holders of positions seek to trade prior to expiration of the contract, among other things. This is consistently seen in comparable energy futures trading; by contrast, it is not reflected in the RIN market.

In order to compare the liquidity of the D6 RIN market to that of comparable energy futures markets, NERA assessed transaction volume as a percent of total outstanding contracts for both markets. For D6 RINs, NERA aggregated into monthly transaction volume the data from EPA, which are available by vintage on a weekly basis. NERA calculated total supply of a given D6 RIN vintage as equal to total vintage generation less the number of retired RINs of the same vintage. Both RIN generation and retirement data are provided by the EPA.

[45] Defined for the purposes of this white paper as the ratio of trade volume to total RIN supply.

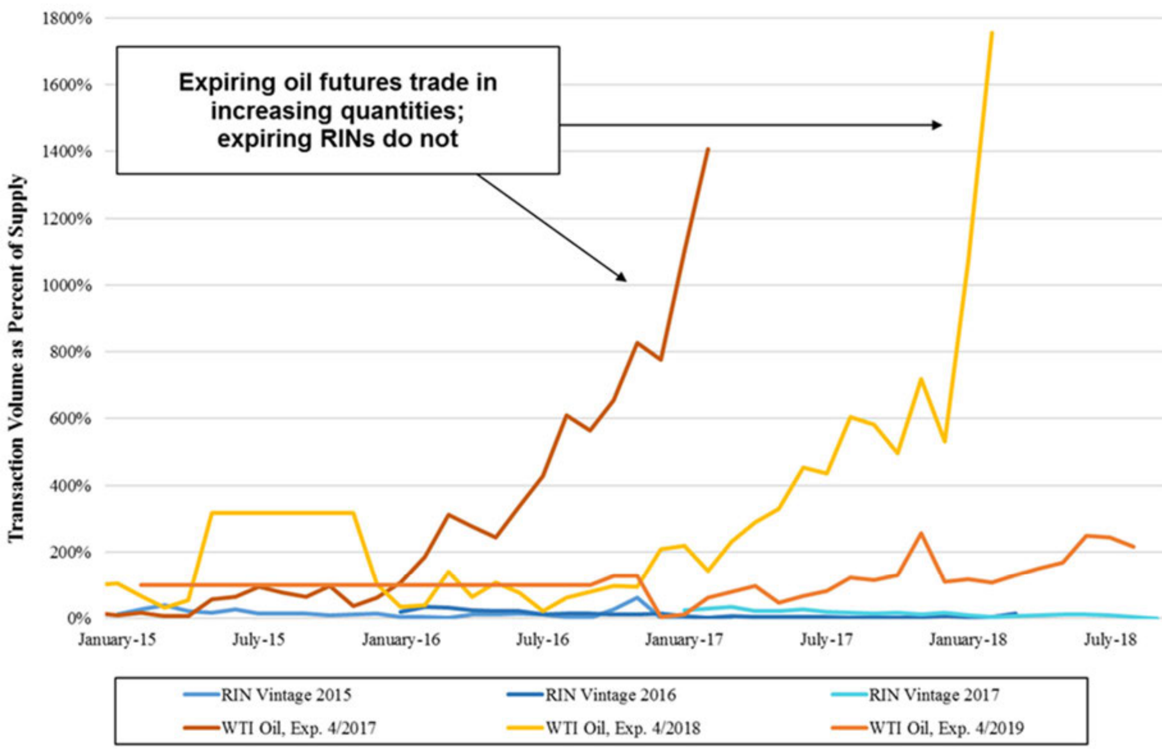
[46] Defined for the purposes of this white paper as the ratio of trade volume to open interest.

For comparable energy futures (WTI oil, ethanol, and natural gas), NERA evaluated changes in both transaction volume and contract open interest from Bloomberg, LP. For comparison purposes, futures contracts were chosen with expiry occurring in April, to coincide with the late-March compliance deadline of RIN contracts.

A comparison of the turnover (ratio of transaction volume to outstanding supply) for both D6 RINs and comparable energy futures indicates that D6 RINs fail to exhibit increasing liquidity as compliance expiry approaches; in contrast, the trend of increasing liquidity as expiration approaches is always observed across oil, ethanol, and natural gas futures markets. In the underlying data, it is clear that for RINs, transaction volume does not increase proportionate to RIN generation or spike as expiry approaches whereas for the energy commodity futures, both transaction volumes and open interest increase significantly as expiry approaches, especially transaction volumes.

Figures 5, 6, and 7 below show that transaction volume as a percentage of outstanding RINs declines as compliance expiry approaches for that vintage. This trend is observed for all RIN vintages between 2015 and 2018. By contrast, liquid energy futures typically see an increase in volume as a percentage of open interest (contract supply) as expiry nears. This increase is much larger for oil (Figure 5) and natural gas futures (Figure 6) than for ethanol futures (Figure 7), although ethanol futures still exhibit a strong upward trend in turnover.

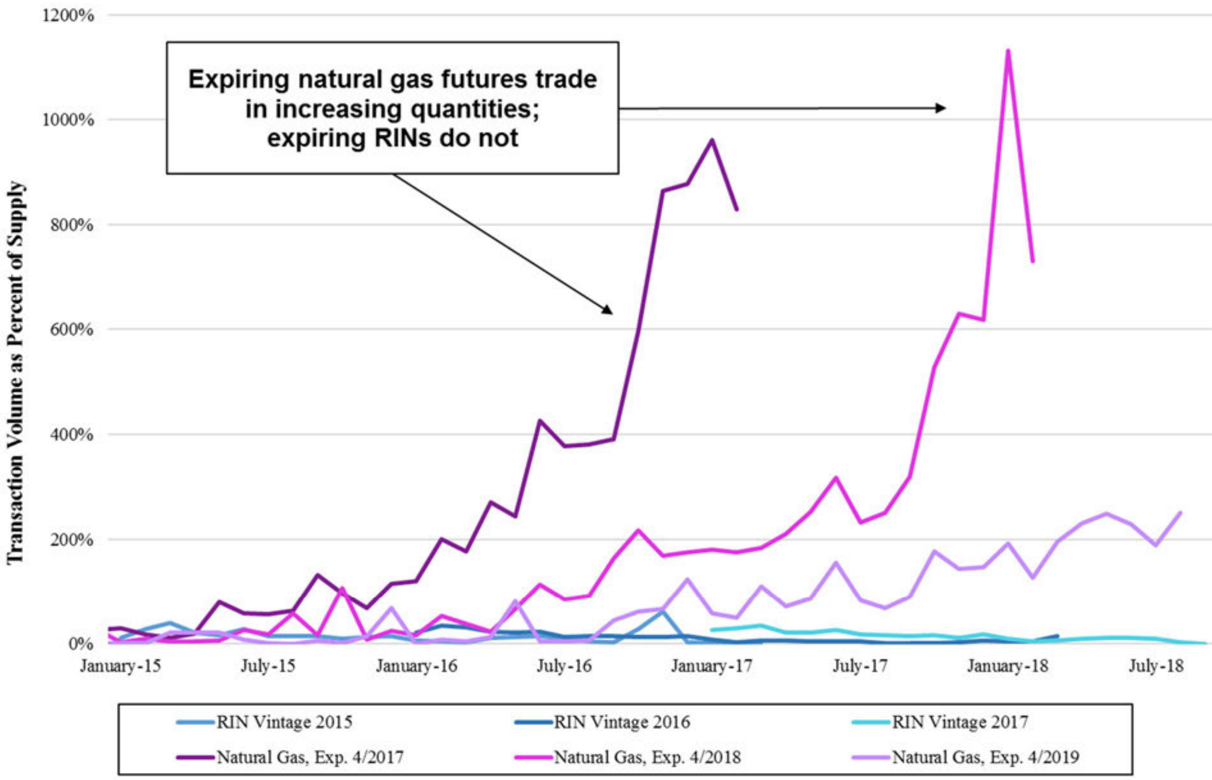
Figure 5
Transaction Volume as a Percentage of Outstanding Contracts[1]
Separated D6 RINs and Comparable Oil Futures



Notes & Sources: RIN data from EPA. Oil Futures data from Bloomberg, L.P.
[1]For RINs, volume as a percentage of outstanding contracts is calculated as RIN transaction volume (separated only) divided by cumulative RINs generated for a given vintage less retired RINs. For Oil Futures, volume as a percentage of outstanding contracts is calculated as transaction volume divided by open interest.

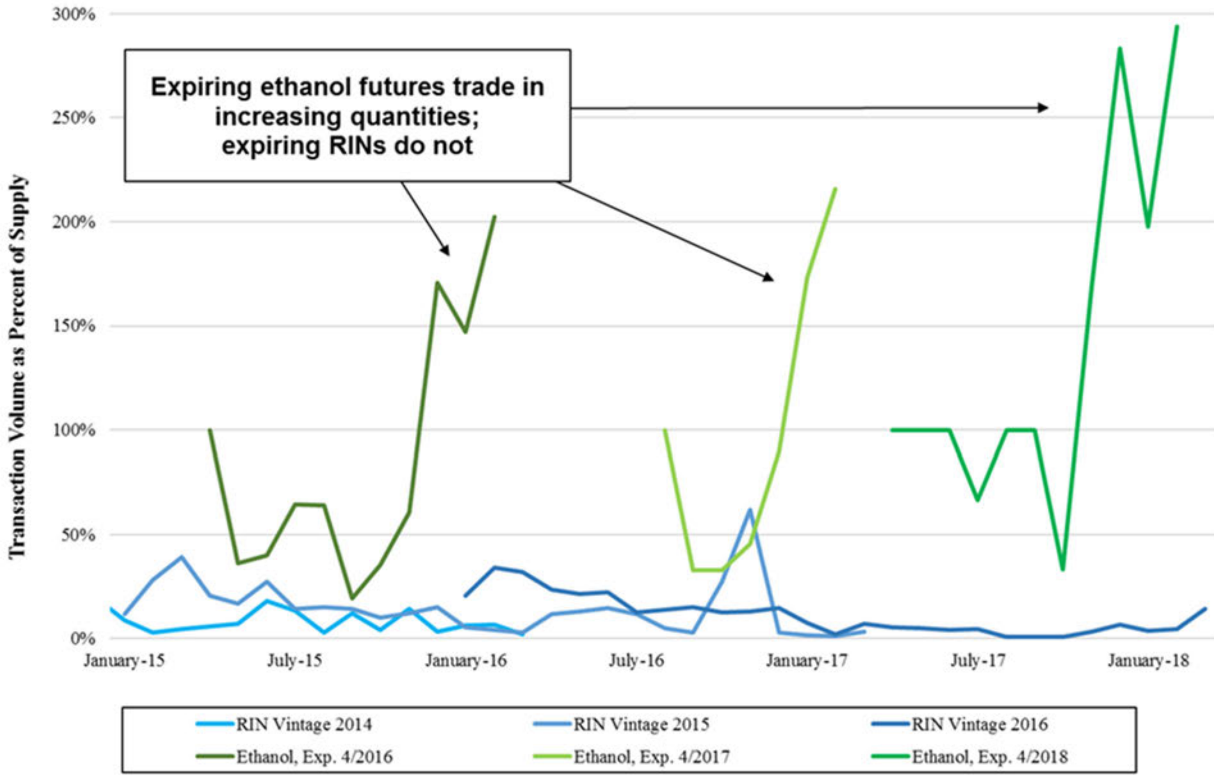
The absence of an upward trend in transaction volume relative to available supply as compliance dates approach, particularly when coupled with the paucity of RIN transaction volume, suggests that illiquidity may impede efficient price discovery in the RIN market when it is most needed.

Figure 6
Transaction Volume as a Percentage of Outstanding Contracts[1]
Separated D6 RINs and Comparable Natural Gas Futures



Notes & Sources: RIN data from EPA. Natural Gas Futures data from Bloomberg, L.P.
[1]For RINs, volume as a percentage of outstanding contracts is calculated as RIN transaction volume (separated only) divided by cumulative RINs generated for a given vintage less retired RINs. For Natural Gas Futures, volume as a percentage of outstanding contracts is calculated as transaction volume divided by open interest.

Figure 7
Transaction Volume as a Percentage of Outstanding Contracts[1]
Separated D6 RINs and Comparable Ethanol Futures



Notes & Sources: RIN data from EPA. Ethanol Futures data from Bloomberg, L.P.
[1]For RINs, volume as a percentage of outstanding contracts is calculated as RIN transaction volume (separated only) divided by cumulative RINs generated for a given vintage less retired RINs. For Ethanol Futures, volume as a percentage of outstanding contracts is calculated as transaction volume divided by open interest.

3.3. Effective Bid-Ask Spread

Although currently available RIN data do not provide a transparent window into observed or quoted bid-ask spreads,[47] effective spreads estimating the execution cost actually paid by a trader to a liquidity provider[48] can be approximated utilizing long-established statistical models. NERA utilizes Richard Roll's seminal model ("Roll model"), as described in his 1984 paper *A Simple Implicit Measure of the*

[47] The difference between the prevailing best offer price quote and best bid price quote is commonly referred to as the observed or quoted bid-ask spread.

[48] Transactions can occur at prices other than prevailing best bid and offer. In markets where quote data are available, effective spreads are sometimes estimated by calculating the difference between the transaction price and the mid-price halfway between the prevailing best bid and best offer as a percentage of the mid-price. See, for example, Bessembinder, Hendrik, and Kumar Venkataraman. "Bid-ask spreads: Measuring trade execution costs in financial markets." Encyclopedia of quantitative finance (2010): 184-190. Relevant information at PDF pp. 4-5, available at http://people.smu.edu/kumar/files/2016/06/BV_EQF.pdf. In markets without reliable quote data, methods using daily price data can be used instead. The most widely recognized and cited of these methods is explored in the rest of this section.

Effective Bid-Ask Spread in an Efficient Market,[49] to estimate spreads for both the D6 RIN market and comparable energy commodity futures. The Roll model has been used in numerous studies of financial and commodities markets and has been shown to be a reliable means to estimate spreads in markets reporting daily data.[50] The results suggest that effective spreads in the RIN market regularly experience significant shocks which move transaction costs to higher levels than found in comparable energy commodity futures markets.

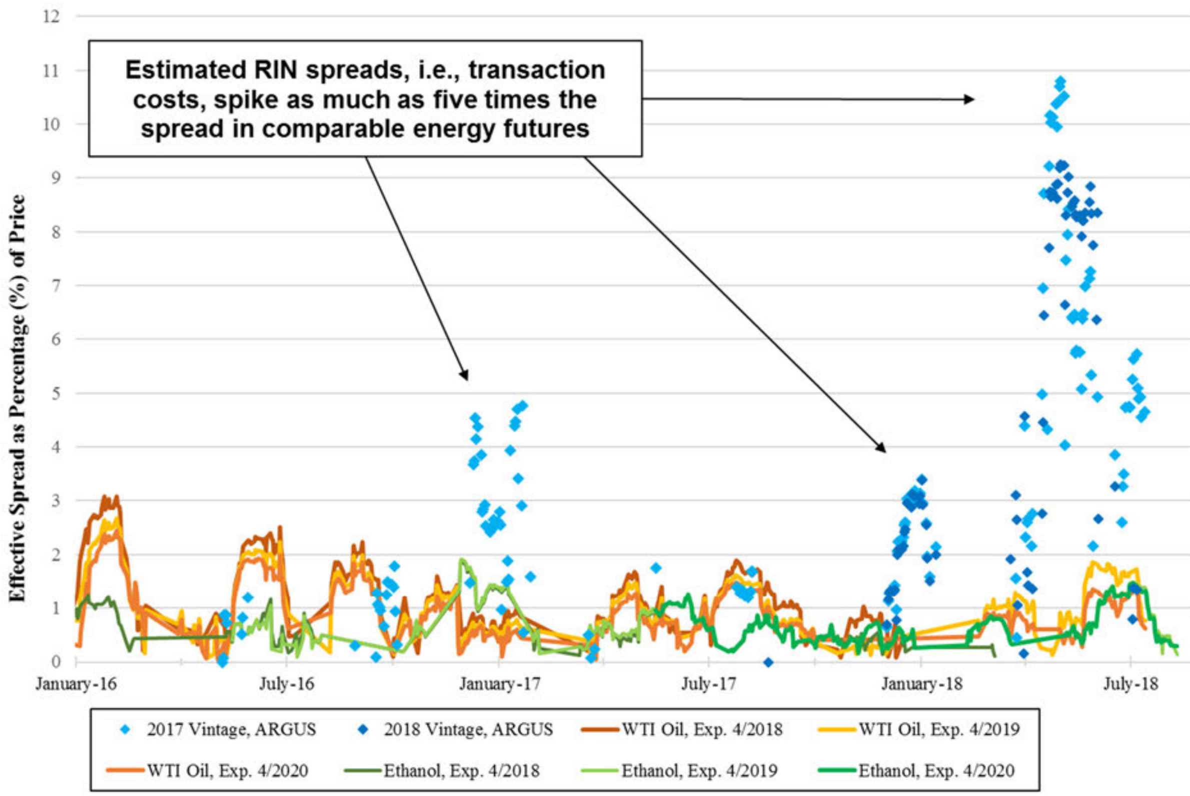
Applying the Roll model, NERA found that the estimated effective bid-ask spreads for RIN markets reflect significant transaction costs borne by those trading in the RIN market. Figure 8 below illustrates estimated effective spreads calculated using the Roll model for the currently active RIN vintages, as well as comparable oil and ethanol futures estimated spreads. The graph shows that, although RIN effective spreads appear to have troughs comparable to the effective spreads typical of other energy commodities, RIN spreads regularly are subject to large spikes, to the extent of up to five times higher than are observed in comparable energy markets. This implies that RIN market participants routinely face transaction costs five times greater than those experienced by other energy commodity market participants.

[49] Roll, Richard. "A simple implicit measure of the effective bid-ask spread in an efficient market." *The Journal of finance* 39.4 (1984): 1127-1139. Relevant information at p. 1127.

[50] The Roll model can be applied to a series of daily prices, and evaluates instances of negative serial covariance in daily price changes for some or all of the dates available, reflecting stationary actual value of the asset. Utilizing daily prices for D6 RINs from Argus and OPIS, as well as daily comparable futures prices, NERA calculated 30-day serial covariance in daily price change for all data series. These daily covariances can then be applied to the Roll model's primary equation, which can be expressed as: $Spread = 2\sqrt{-cov}$.

The resulting figures are a daily estimate of effective spreads, representative of economic transaction costs experienced by market participants in the market.

Figure 8
Effective Bid-Ask Spreads Calculated Using Roll (1984) Method[1]
January 2016 – July 2018



Notes & Sources: RIN Data from ARGUS and OPIS. Commodity futures data from Bloomberg, L.P.
[1]Effective bid-ask spreads represent the economic transaction costs paid by a market participant to a liquidity provider. See *A Simple Implicit Measure of the effective Bid-Ask Spread in an Efficient Market,* Richard Roll, September 1984, for details on this method.

3.4. Time Value and Inefficient Market Prices

RINs can be used for only one end use purpose: meeting obligated party RVO compliance requirements. From the perspective of RVO obligated parties, valid, non-expired RINs of both the current vintage and prior vintage can all be applied to meet the current compliance year's RVO, but only RINs of the current compliance year's vintage have the optionality to be used during either the current or next compliance year. Thus, rational pricing should show nearest-expiry RIN vintages trading at a discount to newer vintages. In financial economics, this concept is called time value, and is often used to analyze option value. For example, when comparing two otherwise identical American-style options with different expiration dates, the option further from expiry should always be at least as valuable as the option closer to expiry. To consider an everyday analogy, it is akin to choosing between otherwise identical flight vouchers from the same airline with different expiration dates. If both vouchers offer identical benefits, but one expires this year and the other expires one year later, rational consumers should never prefer the voucher closer to expiry, and will pay less for those.

NERA examined the price differentials between nearest-expiry RIN vintages and the second available (i.e., more recent) vintage to determine whether market pricing is consistent with market efficiency by obeying the principle of time value mentioned above. NERA found dozens of weeks for which nearest-expiry RINs were priced above the next available vintage. This result suggests that the RIN market produces negative time value outcomes that are contrary to rational pricing expectations.

NERA used D6 RIN pricing data from three sources: EPA, Argus, and OPIS. EPA data provides prices on a weekly basis for each vintage, and only the "Unverified" pricing source was considered due to lack of Q-RIN[51] data on certain dates. For Argus and OPIS, daily prices were evaluated, as were aggregated weekly average prices (for ease of comparison with EPA data for both sources).

Daily and weekly RIN prices from each data provider were compared across vintages to test for negative time-value pricing. For example, weekly price differences were calculated as the 2011 vintage price less the 2010 price, and so on for other vintages.

Figure 9 below shows the total number of weeks where a negative time value for nearest-expiry RINs is observed across the three data sources. These repeated instances of negative time value are material and are an additional indicium of RIN market behavior not conforming to rational market pricing.

Figure 9
RIN Pricing by Vintage: Weeks During Which Negative Time Value Is Observed

	Price Differences Between Vintages:							
Nearest Expiry Vintage:	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Next Vintage:	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Number of Weeks Where EPA Data Shows Negative Price Relationship:[1]	3	15	44	47	43	25	29	7
Number of Weeks Where Argus Data Shows Negative Price Relationship:[1]	0	0	0	30	51	48	12	10
Number of Weeks Where OPIS Data Shows Negative Price Relationship:[1]	0	0	0	31	67	39	11	4

Notes & Sources: RIN pricing data from EPA, OPIS, and Argus.

[1] A negative price relationship is defined as a price for the nearest expiry vintage which is higher than the price of the next most recent RIN vintage, implying an irrational negative time value for near-expiry RINs. Prices are compared on a weekly average basis.

Figure 10 below shows the total number of days for which a negative time value for nearest-expiry RINs is observed across Argus and OPIS data, which is an additional indication of the RIN market not functioning as expected for a derivatives market.

[51] RINs that have been verified by a provider of the EPA's Quality Assurance Place ("QAP") are referred to as Q-RINs. See https://www.epa.gov/fuels-registration-reporting-and-compliance-help/public-data-renewable-fuel-standard.

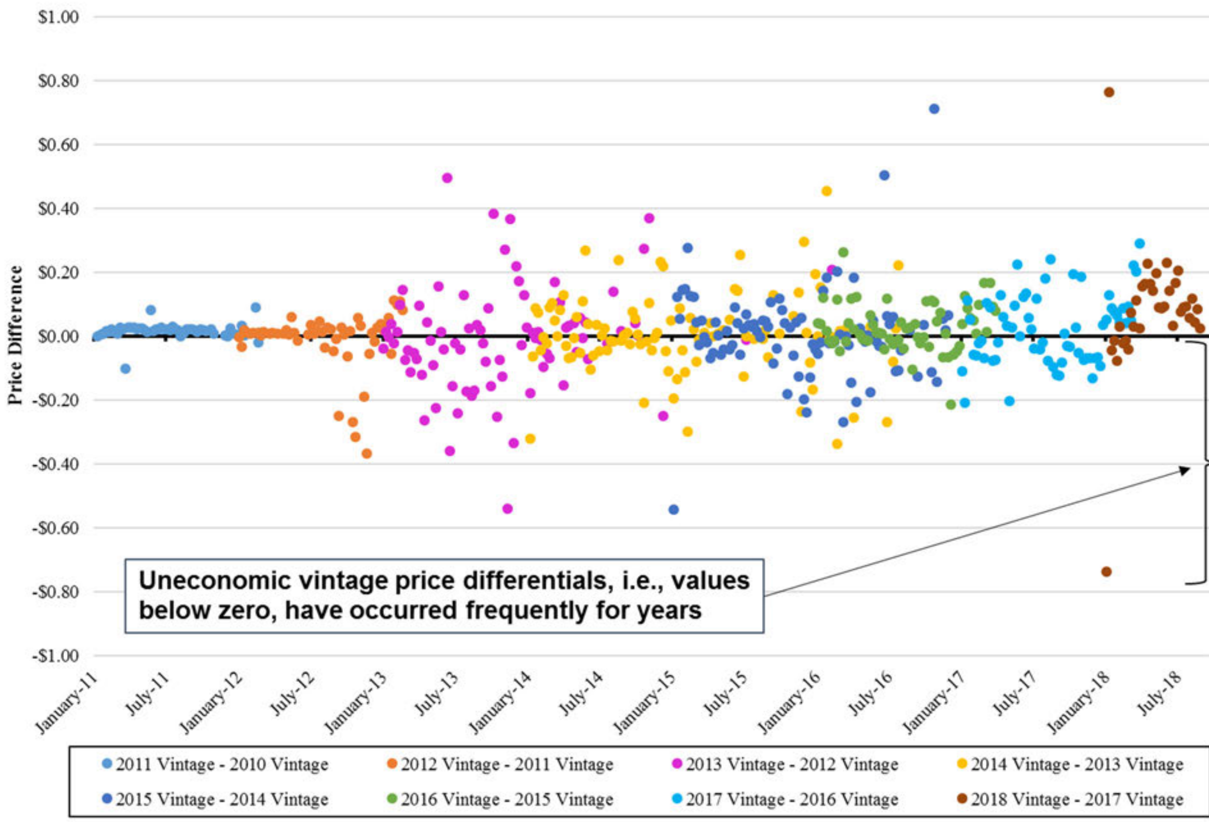
Figure 10
RIN Pricing by Vintage: Days For Which Negative Time Value Is Observed

Nearest Expiry Vintage: Next Vintage:	2012 2013	2013 2014	2014 2015	2015 2016	2016 2017	2017 2018
Number of Days Where Argus Data Shows Negative Price Relationship:[1]	0	125	234	205	51	45
Number of Days Where OPIS Data Shows Negative Price Relationship:[1]	6	126	280	164	42	14

Notes & Sources: RIN pricing data from OPIS and Argus.

[1] A negative price relationship is defined as a price for the nearest expiry vintage which is higher than the price of the next most recent RIN vintage, implying an irrational negative time value for near-expiry RINs.

Figure 11
EPA Price Difference: Current Vintage – Prior Year Vintage
2011 – Present

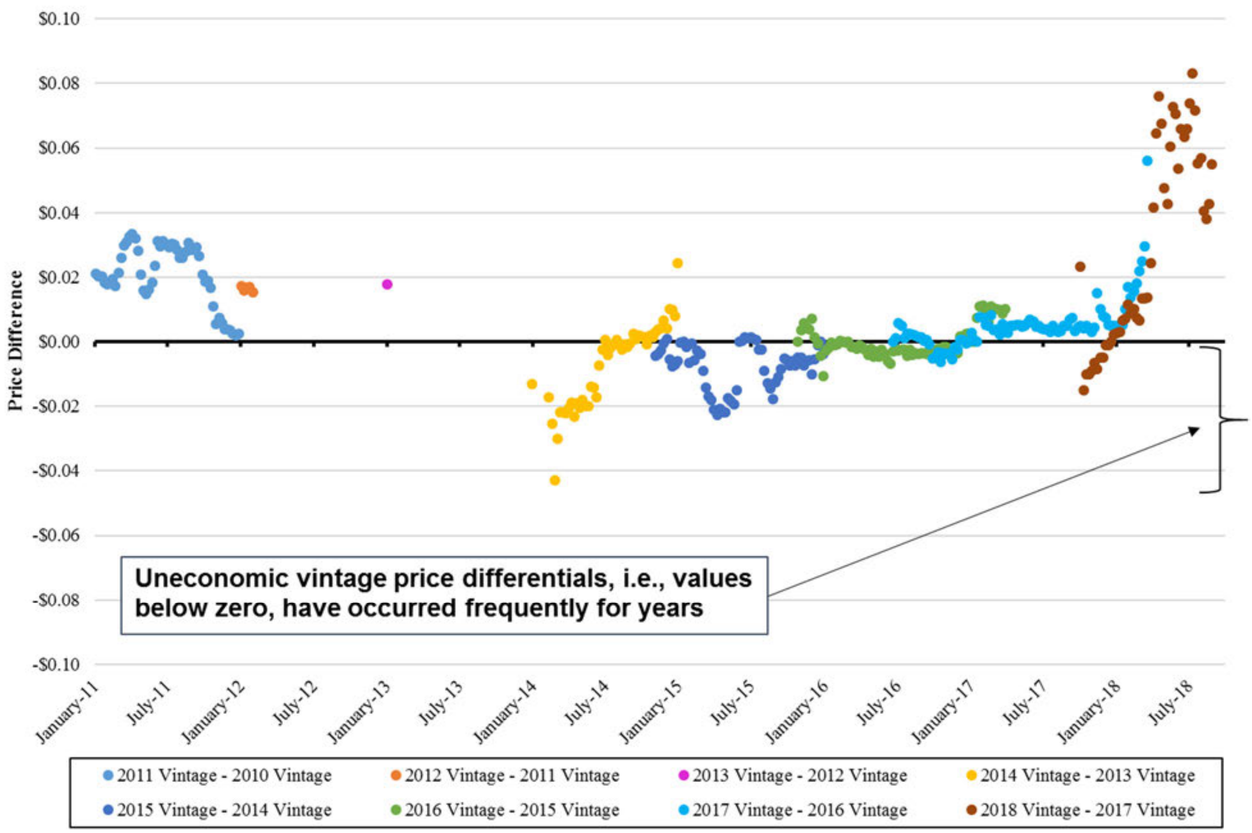


Notes & Sources: RIN Data from EPA. Only Unverified RIN price series considered due to lack of data for Q-RIN pricing series.

Figures 12 and 13 show the similarly significant frequency of price differences below zero across vintages in weekly averages of Argus and OPIS price data (all data points below the bolded X-axis).

NERA observed that the differences repeatedly occur over a number of years. Figure 11 shows the magnitude and frequency of price differences below zero across vintages in weekly EPA price data (all data points below the bolded X-axis).

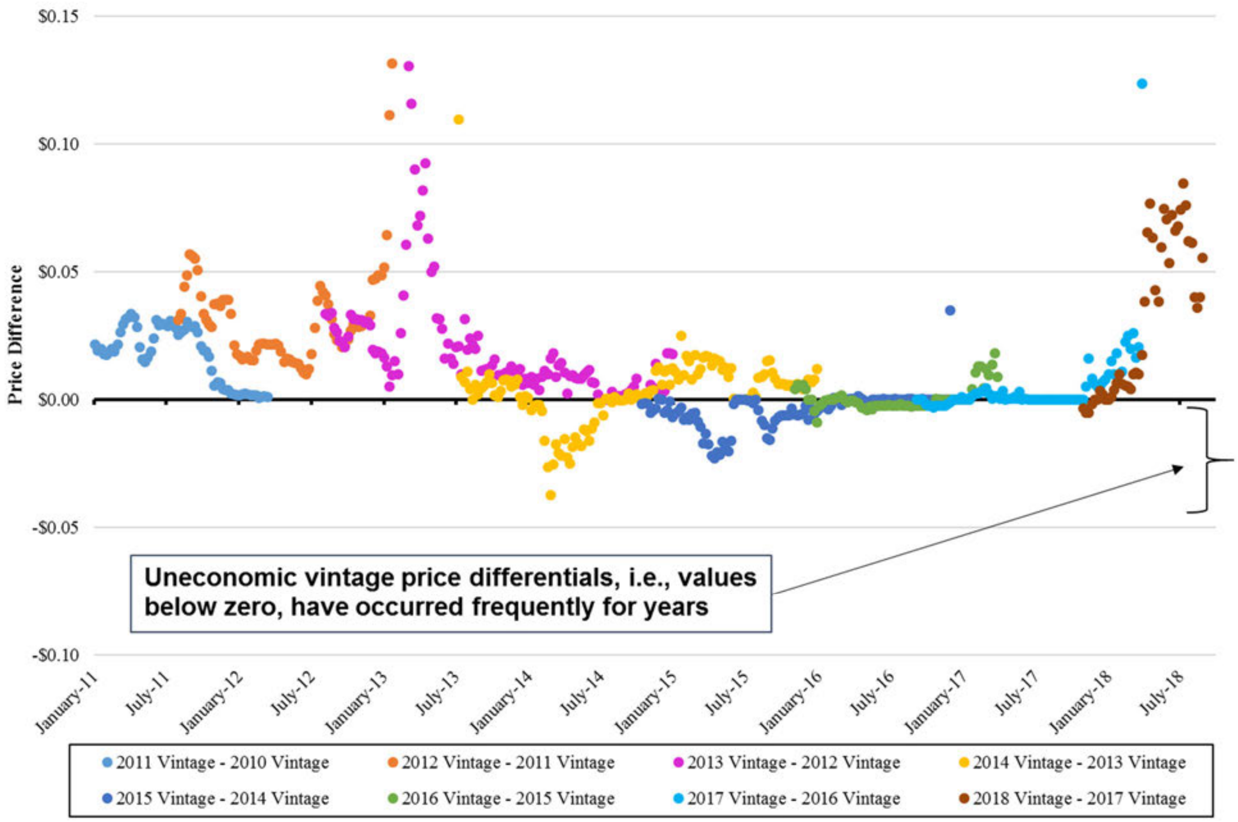
Figure 12
Argus Price Difference: Current Vintage – Prior Year Vintage
2011 – Present



Notes & Sources: RIN Data from Argus.

NERA found that in hundreds of days across dozens of weeks for each price data source, RINs of a nearer expiry date are reported as worth more in the market than identical RINs of later vintage with more optionality. This indicates that the RIN market produces economically inefficient prices relatively often, and problems with negative time value persist even in recent years. One finding of note for potential future analysis is that the EPA data shows price differentials across vintages that are much larger in magnitude than those of Argus and OPIS. The underlying cause of the larger magnitude of EPA price differentials across vintages is not readily apparent from the data.

Figure 13
OPIS Price Difference: Current Vintage – Prior Year Vintage
2011 – Present



Notes & Sources: RIN Data from OPIS.

Although it has not been determined with certainty the cause of the negative price differentials in RIN market price data using the aggregates available to NERA at present, several potential causes merit consideration by authorities with more granular data. These potential causes include:

- Market Fragmentation: If different segments of the market tend to trade prior year vintages and current year vintages, and those respective market segments do not routinely transact, price discovery for one vintage may not reach all segments of the market quickly enough to allow for same-day or even same-week arbitrage. A fragmented market would inhibit both price discovery and market efficiency.
- Hoarding: If RINs are withheld and price discovery is relatively slow or the market is fragmented, hoarding could result in short term price spikes for the vintage withheld. For example, if prior year RINs are in short supply due to withholding, but current year RINs are not, and different traders tend to trade each, in the short term, prior year RIN prices might rise relative to current year RIN prices despite the higher time value optionality of current year RINs. Until and unless the negative time value is ameliorated by traders engaging in effective arbitrage, fragmentation could allow hoarding to persist and ultimately drive irrational pricing that imposes costs on RIN-short parties.

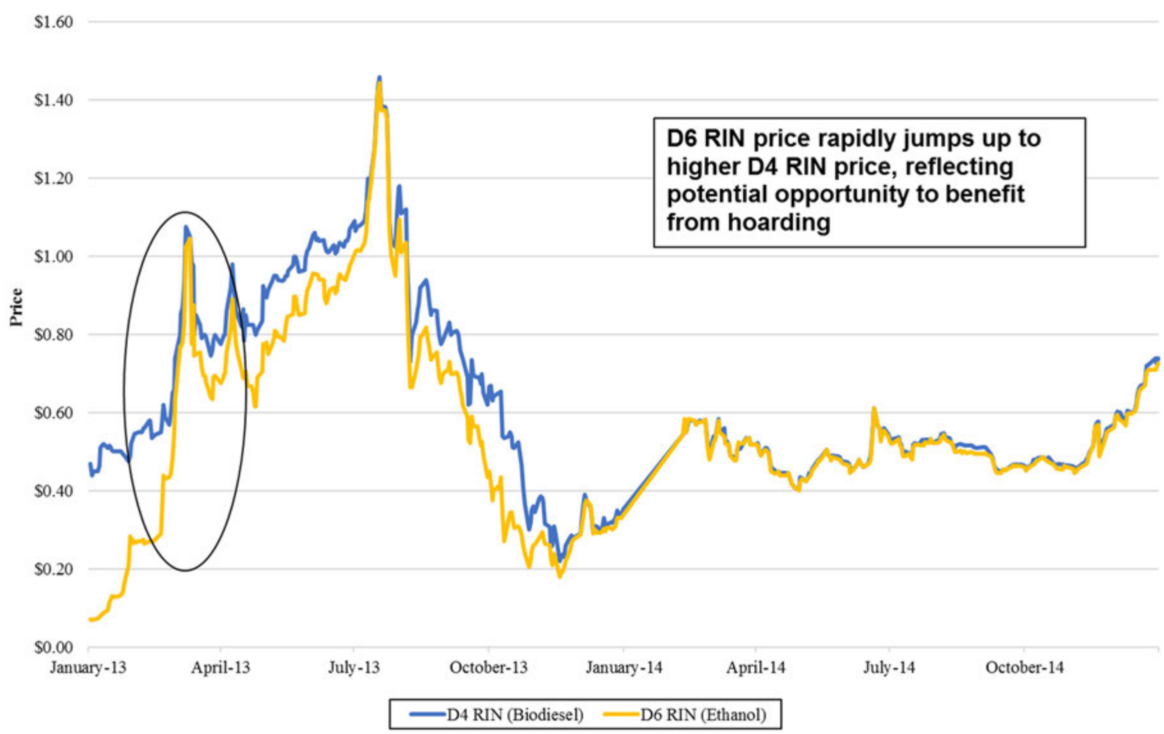
3.5. Supply Fundamentals and Potential Hoarding

NERA examined historic D6 ethanol RIN and D4 BBD RIN price trends, and found evidence of D6 price step-ups that rapidly converge with D4 prices, as well as D6 price step-downs that rapidly decouple and fall from D4 prices. NERA utilized Argus daily prices of D4 and D6 RINs for the vintages 2013, 2014, and 2015. NERA charted the prices of D4 and D6 RINs over time for each vintage.

NERA then analyzed the charts and identified potential D6 price step-ups. Such steps are characterized by sudden jumps in the lower D6 prices and convergence to the higher D4 prices. When the D6 and D4 prices are on the same step, they generally track closely. Step-downs can also be observed, during which D6 RINs rapidly return to lower price levels and diverge from D4 prices. NERA then confirmed that these results could also be obtained using OPIS price data.

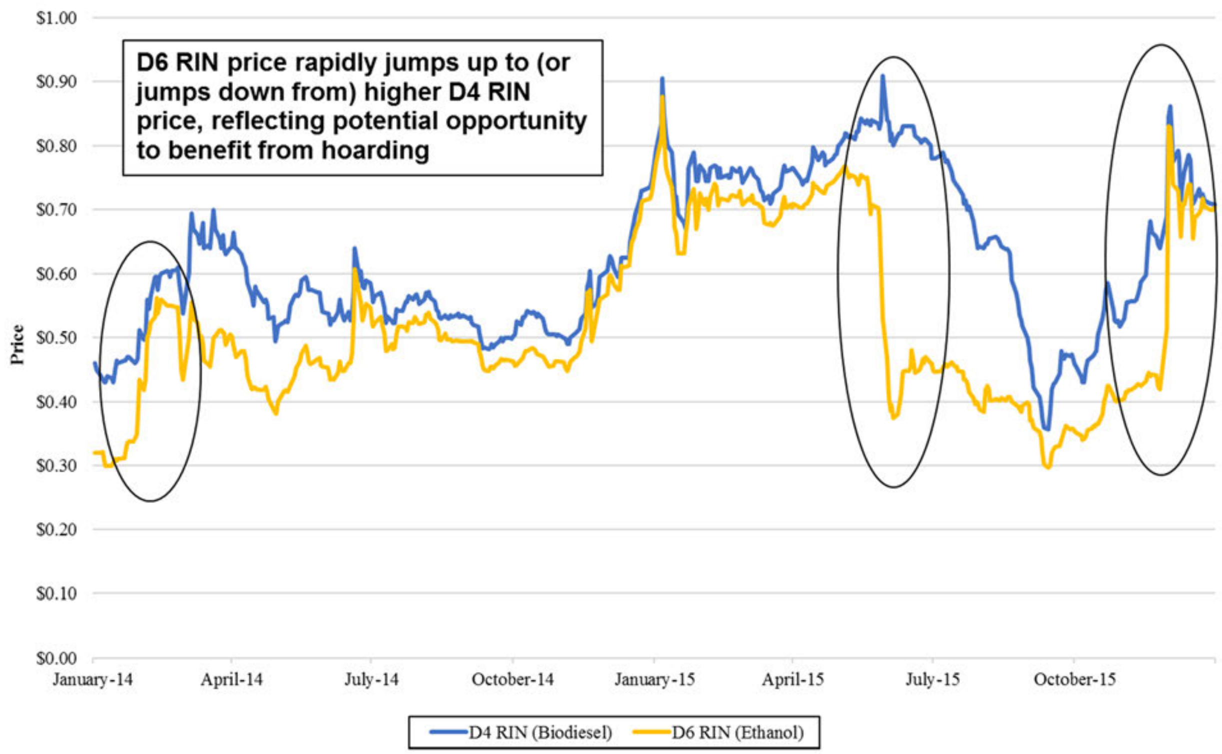
Figures 14, 15, and 16 below demonstrate the presence of step-ups and step-downs in the RIN Market. Such step-like price movements have occurred multiple times in recent years.

Figure 14
D6 and D4 RIN Prices: 2013 Vintage



Notes & Sources: RIN Data from Argus. Identified price steps are circled.

Figure 15
D6 and D4 RIN Prices: 2014 Vintage



Notes & Sources: RIN Data from Argus. Identified price steps are circled.

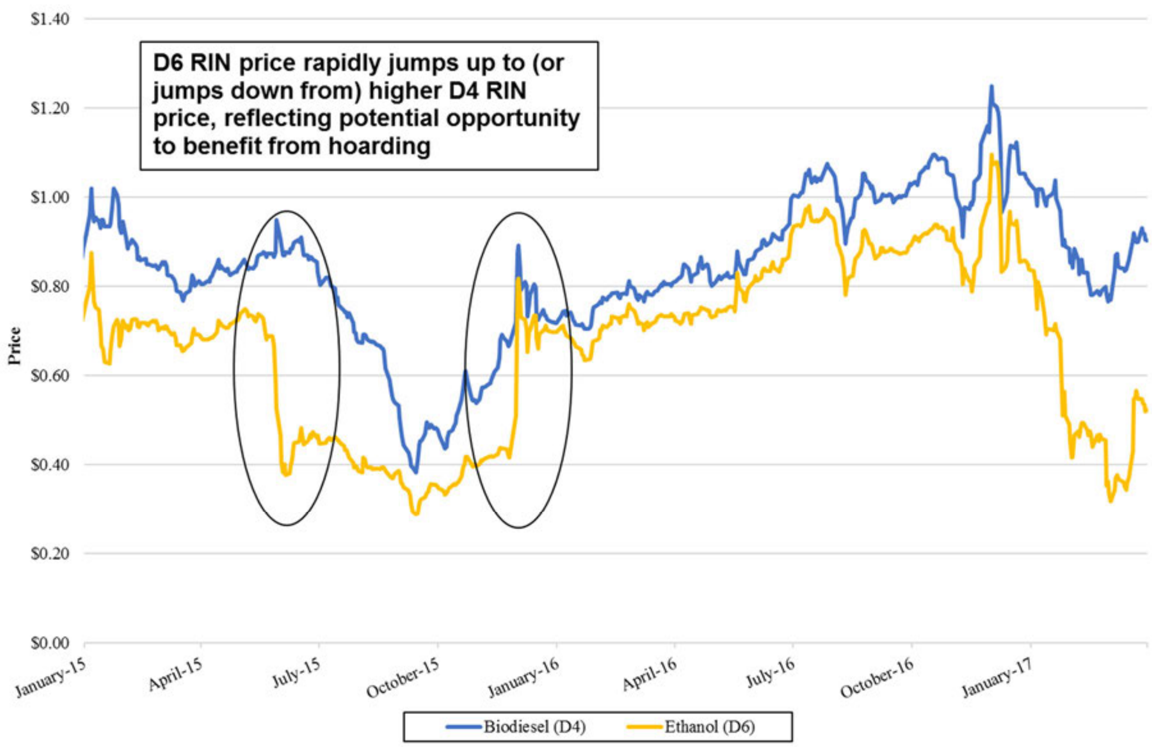
NERA analyzed market fundamentals in order to model the supply and demand curve causes of this observed step-up and step-down price phenomenon. NERA's analysis of market fundamentals suggests that the structure of supply in the D6 RIN market is likely to exhibit sudden upward discontinuities or steps in price in the short and medium run (i.e., during a single compliance year). This is the result of the time and investment in physical capital infrastructure necessary to substantially increase ethanol generation capacity, as existing plants can be pushed only somewhat beyond nameplate production capacity[52] in response to high D6 RIN prices, and not indefinitely. If D6 RINs fall sufficiently short of RVO compliance needs, substitution from other RIN categories, such as D4 BBD RINs, is the logical market response, and D6 RIN prices should converge with the prices of these more expensive to deliver substitutes.[53] This is akin to the cheapest-to-deliver phenomenon in futures markets described in Section 2.2 and footnote 26 of this study. In its 2018 study titled *Ethanol RIN Waiver Credits: Improving Outcomes of the Renewable Fuels Standard through a Price Containment Mechanism*, Charles River

[52] Nameplate production capacity is measured as a plant manufacturer's stated design capacity to produce fuel ethanol during a 12-month period. See https://www.eia.gov/todayinenergy/detail.php?id=31832.

[53] While convergence to the next-cheapest-to-deliver RIN is an expected outcome of RIN market design, if caused by withholding supply of D6 cheapest-to-deliver RINs leading to a significant step up in prices, the resulting volatility and cost to parties who are short RINs diminishes market quality.

Associates also hypothesized that the RIN supply curve resembles a step function, in which large price jumps can occur due to relatively small changes in demand.

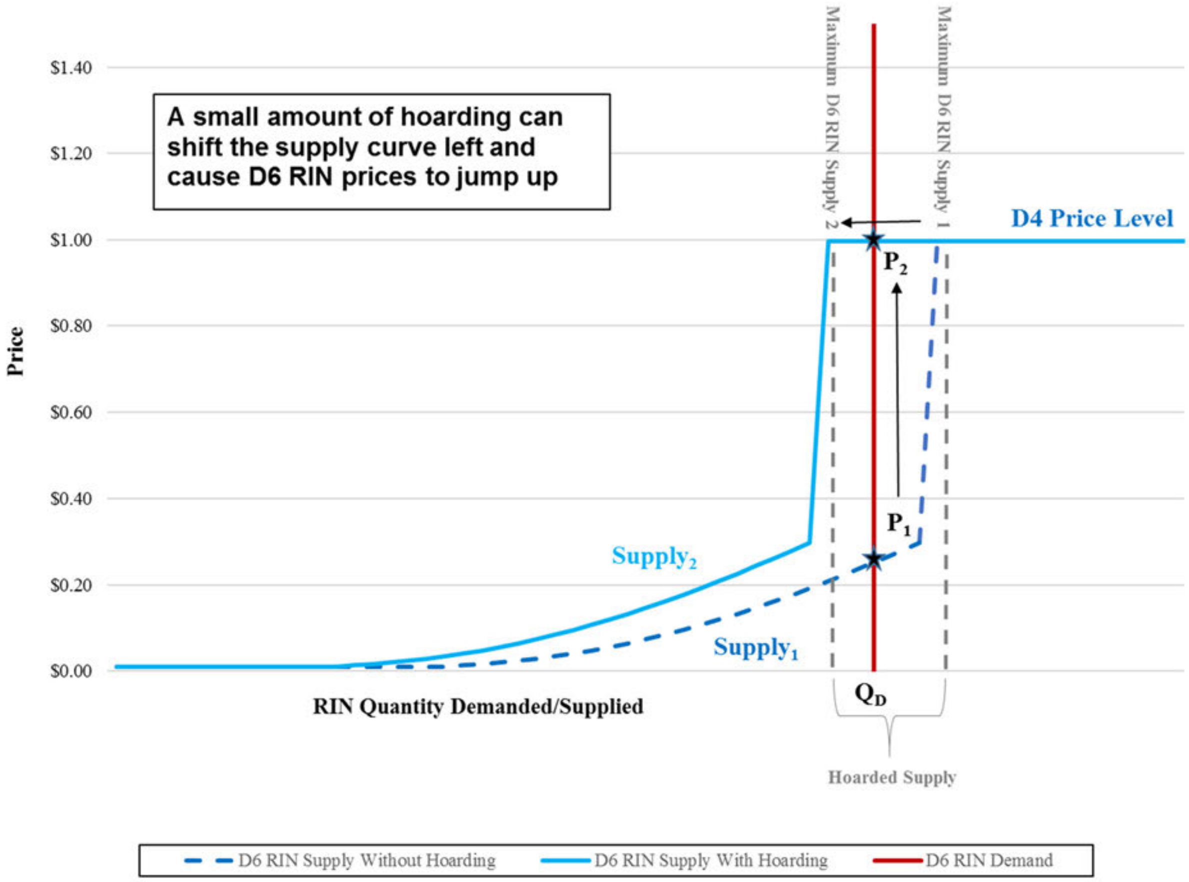
Figure 16
D6 and D4 RIN Prices: 2015 Vintage



Notes & Sources: RIN Data from Argus. Identified price steps are circled.

Figure 17 below illustrates a simple medium-term model of supply and demand in the D6 RIN market, with a vertical demand curve reflecting the effectively fixed-value nature of RVOs established by the EPA. The supply curve begins horizontally at a price of zero because, even absent RFS2 and RIN pricing, some ethanol would be produced and blended with traditional fuels. To the right of this flat section of the supply curve is an upward-sloping supply curve representing the use of increasingly inefficient ethanol plants (or the costly pushing of existing ethanol plants beyond nameplate capacity) as D6 RIN prices increase. Eventually the supply curve hits a wall beyond which increased ethanol production is not possible for current year compliance. At this point, substitution from other RIN types, particularly D4 BBD RINs, becomes necessary to comply with RVOs, and D6 RINs approach price parity with D4 RINs. The approximately vertical nature of the D6 RIN supply curve at the step up to D4 RIN price parity suggests that even a marginal amount of hoarding could cause a significant increase in price. This could incentivize hoarding by longs who would stand to gain from an increase in the price of their holdings.

Figure 17
Illustrative D6 RIN Market Supply and Demand Model
Potential for Substantial Price Increase Resulting from RIN Hoarding



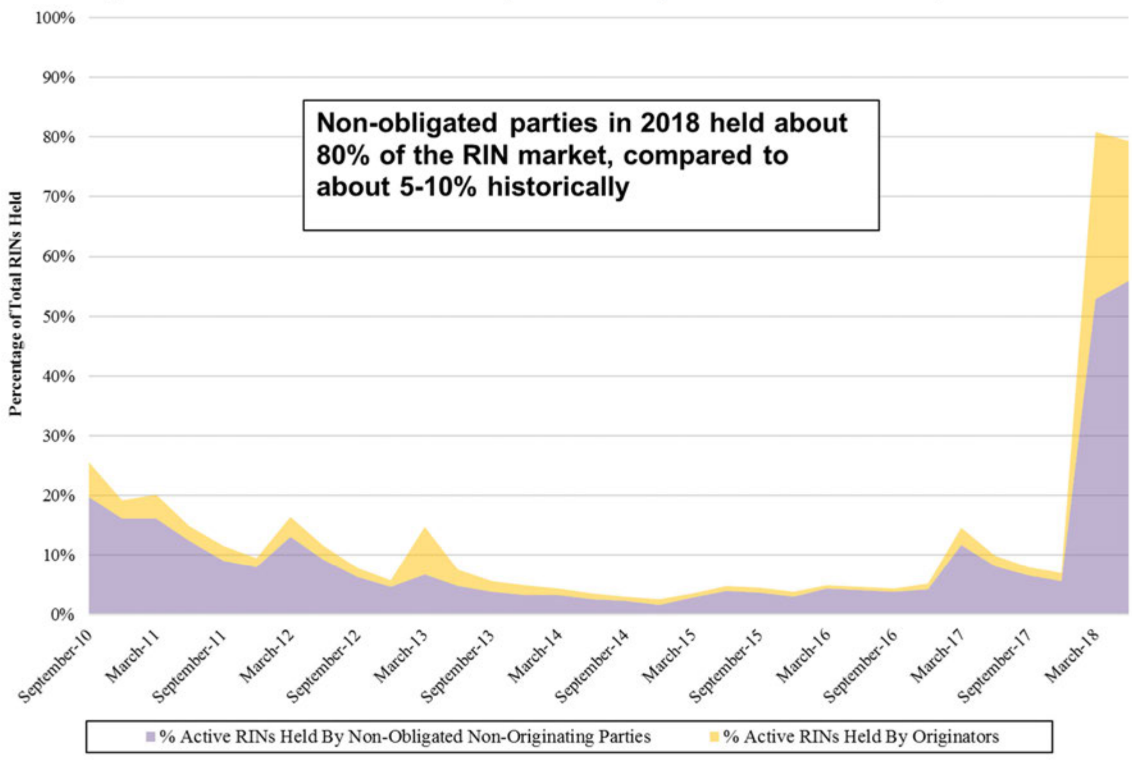
RIN markets are distinctive among commodity markets because the only end use for RINs is demonstrating regulatory compliance. In the absence of legitimate hedging or end use needs besides demonstrating compliance with RVOs, the theoretical consequences of market participants holding RIN inventories substantially in excess of RVOs are predictable: hoarding resulting in reduced liquidity, the supply curve shifting left (reflecting reduced supply), and higher prices in the market until the hoarded RINs are made available to the market.

NERA analyzed EPA RIN holdings data in order to determine whether hoarding is plausible given market data. NERA's analysis determined that non-obligated parties typically have held 5%-10% of available RINs at any given point in the compliance cycle until this year. The publicly available EPA data does not separately identify holdings of RINs by entities in excess of the entity's RVO, so these estimates of holdings by non-obligated parties merely represent a floor on speculative positions in the RIN market. Given the likelihood that the RIN market supply curve has step-like discontinuities resulting in much higher prices, further analysis by those with more granular data, such as the EPA, could determine whether inventories far in excess of RVOs and held by entities without RVOs is associated with higher prices, more volatility, lower liquidity, or wider effective bid-ask spreads.

NERA analyzed the EPA's publicly available RIN holdings data by market participant category. The EPA identifies only five categories of RIN holders: Refiners, Importers, Exporters, RIN Originator, and RIN Owner. The first three categories can be considered together to be RFS obligated parties, which must obtain RINs for compliance purposes each year.[54] RIN Originators, on the other hand, are non-obligated parties that generate any amount of RINs during the compliance year. Finally, RIN Owners consist of any RIN holder who was neither an obligated party nor a RIN Originator, and therefore participate in the RIN market as liquidity providers or speculators.

By aggregating holdings data into a measure of total RIN holdings, NERA observed that non-obligated parties typically hold about 5% - 10% of the available RINs across all eligible vintages at any given time. Figure 18 below depicts that this trend was fairly stable from 2013 through 2017, and then changed dramatically in 2018 when non-obligated parties increased their holdings to approximately 80% of total supply. Had this been a CFTC-regulated market, an increase in speculative positions as a proportion of deliverable supply of that magnitude would likely trigger an inquiry into the positions to determine the intentions and commercial purpose for such positions. Similarly, the EPA can determine whether this significant increase in reported speculative positions by non-obligated parties in the most recent data aggravated obligated parties' ability to effect compliance, or reflects a change in market conditions.

Figure 18
Percentage of Total Valid RINs Held by Non-Obligated Market Participants



Notes & Sources: RIN holdings data from EPA.

[54] However, no granularity is provided as to the size of obligated parties' RVOs, which is potentially a consequential omission owing to the ease with which an entity can become an obligated party, e.g., by importing a small quantity of refined fuel.

Given that non-obligated parties generally have holdings in excess of 5% of total RIN supply and regularly approach and sometimes even exceed 10% of available RINs, and given the likelihood that the RIN market supply curve follows a step function, it is possible for non-obligated parties to withhold and release RINs in a manner which moves supply across hypothesized supply curve steps, resulting in jumps in price disproportionate to the change in available RINs. This would be substantially more likely if some market participants hoard RINs well in excess of their RVOs, which would not be visible in publicly-available data due to the absence of more granular categories of market participants. RIN longs may benefit from higher prices for those RINs that they held and then eventually sold in the market.

3.6. Opacity

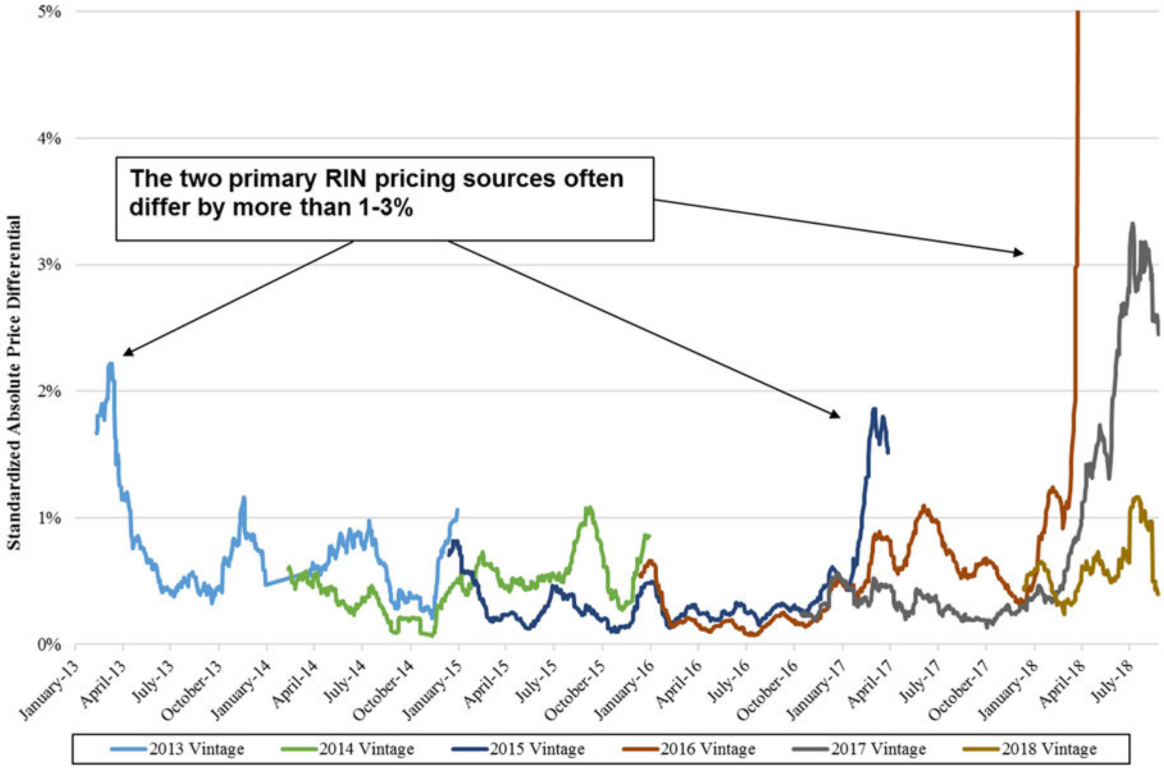
RIN market participants have two primary sources for daily historical price and volume data: the data vendors Argus and OPIS. The data vendors provide subscribers with both historical time series and periodic reports on “deals done” in the RIN and biofuels markets, and are an important means by which price information is transmitted across the entire market to reduce fragmentation. However, both Argus and OPIS rely on voluntary submissions of data on “deals done” by contributing market participants, and neither vendor purports to receive deals data from more than a fraction of the market, with some (but limited) overlap among data contributors between OPIS and Argus. As a result, it is possible that Argus and OPIS are reporting substantially different “deals done,” and thus are showing different pictures of RIN market price discovery on any given day, especially if the RIN market is fragmented. This could result in an opaque market whereby multiple days are needed for many market participants to confirm the incorporation of new information into prices, which could slow price discovery and market efficiency.

In order to examine the extent to which Argus and OPIS daily price data diverge, NERA examined rolling averages of the absolute value of the price differential as a proportion of the Argus price. NERA found that the price differential is almost always at least 0.5%, and in 2017 and 2018 has reached above 3% for some vintages. Market participants relying on the data vendors could miss arbitrage opportunities based on the price uncertainty that could result from seeing divergent prices, which could slow price discovery. In addition, the non-trivial differential between the two primary data sources for RIN prices demonstrates the limited nature of daily RIN data available for analysis, and the potential opacity of price discovery in the RIN market.

NERA used daily price data on D6 RINs from the data vendors Argus and OPIS for this analysis. Argus and OPIS provide daily price data for these RINs by vintage. NERA calculated the absolute value of daily price differences between Argus and OPIS data for all available vintages and dates. NERA standardized these absolute differences as a percentage of the Argus daily price, and further constructed a 30-day rolling average differential for each vintage. NERA found meaningful differences, by as much as 1% to 3%.

Figure 19 below demonstrates rolling average differences between Argus and OPIS D6 RIN prices between 2013 and 2018.

Figure 19
30-day Rolling Average of Standardized Absolute Price Differential[1] between Argus and OPIS D6 Ethanol RIN Prices



Notes & Sources: RIN Data fom Argus and OPIS.
[1] Standardized Absolute Price differential is calculated as the absolute value of Argus daily mid-price less OPIS daily mid-price, and is standardized as a percentage of the Argus price. A rolling average is taken for the preceding 30 trade dates.

4. Potential Reforms

4.1. Transparency and Improved Data Reporting

The EPA collects very little information about the forward transactions and positions that dominate RIN market trading activity or any related derivatives transactions or positions. Financial transactions not resulting in an immediate transfer of title generally are not recorded in EMTS, so the EPA has no reliable way of determining whether any market participants are engaging in hoarding or potentially manipulative behaviors through such transactions. This is a significant regulatory blind spot: although transfers of title may be transparent to the EPA and may display indicia of efficient markets, problematic indicia in forwards and other derivatives may go undetected by the EPA in the absence of relevant regulatory data collection. Moreover, the data that the EPA does collect is made available to the public only in broad aggregates, and private data vendors offer little more than the daily range of prices and volumes volunteered by a subset of the market.

In most other commodity markets, by contrast, the CFTC engages in comprehensive collection of both market data and position data in the markets it oversees in order to ensure that the markets are fair, liquid, and free from fraud and manipulation. The CFTC collects real-time and historical data on spot, futures, options, and related financial markets to detect, deter, and combat manipulation, excess speculation, and market failures like the non-convergence of spot and futures prices at expiry. The market oversight staff continuously monitors the terms and market conditions of products being offered by the exchanges and considers underlying factors that may affect the efficient functioning of the markets that the CFTC oversees. Staff also monitors the level of deliverable supplies and trading patterns in physical and related financial products to identify conditions that may allow a product to be easily cornered or squeezed. They collect and analyze data from clearing firms and commission merchants to create the Large Trader Reporting System, which captures daily position data and enables them to monitor for market concentration and abusive trading practices.

The CFTC also publishes substantial anonymized data on positions (both physical and financial), open interest and transaction volumes, staff analyses of market prices and volumes and, in some markets, clearing and margining activity. The published data and staff analyses provide market participants with valuable insights into market conditions and potential risk factors, and enable them to make informed supply and demand decisions, as well as to engage in more efficient hedging decisions. The CFTC's collection and publication of thorough transaction, position, and market data have also fostered robust private sector data vendor offerings that make most liquid CFTC-regulated markets relatively transparent to market participants by allowing subscribers access to quoting, market depth, and forward curve data. This transparency encourages efficient price discovery and incentivizes market integrity by increasing the odds that manipulative behaviors will be detected and punished.

To address concerns that market participants would have incentives to manipulate futures prices in order to benefit their larger unregulated financial and OTC positions, the Dodd-Frank Act also increased requirements for reporting of swaps. In swaps markets overseen by the CFTC, the CFTC collects transaction-specific data covering both economic terms of most swap transactions and the counterparties and clearing status of those transactions. The CFTC surveillance staff regularly analyzes its data to look for evidence of unusual position concentrations, pricing, or transaction patterns that may indicate attempts to manipulate the markets. Collectively, these factors reduce market fragmentation and encourage price stability.

Similar markets also have favored comprehensive data collection and availability practices. For example, state and regional environmental product markets, like the California Cap-and-Trade Program and the Regional Greenhouse Gas Initiative ("RGGI"), collect thorough data about carbon-allowance obligated parties and transactions in allowances. These state and regional environmental markets create a centralized repository of allowances that are periodically auctioned off, and detailed data about the auctions is made available to the public and market participants. In addition, (anonymized) transaction-level details are made available to the public for all transfers of title in the RGGI program. Moreover, substantial futures market activity provides the forward price data and private data vendor products that are considered by market participants in CFTC-regulated markets.

The table in Appendix A compares data reporting requirements and data availability in the RIN market to similar markets. This shows that similar markets that are not administered by the EPA, such as commodity futures, options, and swaps markets overseen by the CFTC, as well as state and regional carbon allowance markets under cap-and-trade programs, collect more detailed data at the supervisory level, make more data available to market participants, and foster robust data vendor offerings including many fields not available in the RIN market.

4.2. Position and Carryover Limits

Position limits are a widely used tool in commodity markets to prevent excessive speculation and deter and prevent manipulation. Regulators of both traditional energy commodities markets and markets in regulatory compliance instruments like greenhouse gas cap-and-trade allowances have repeatedly stated economic and regulatory rationales for position limits that apply to the RIN market. For example, the CFTC describes properly-designed position limits as addressing "objectives of preventing excessive speculation, deterring and preventing market manipulation, and ensuring that markets remain sufficiently liquid so as to afford end users […] the ability to hedge commercial risks[.]"[55] Likewise, the Interagency Working Group for the Study on Oversight of Carbon Markets ("Carbon Markets Working Group"), a regulatory working group led by the CFTC and including the EPA as well as numerous other regulators, concluded that "the use of position limits and monitoring of participant positions"[56] would allow regulators to reduce the possibility of manipulations and prevent excessive speculation and related market distortions.[57] Both the CFTC and the Carbon Markets Working Group concluded that bona fide hedging exemptions were an important element of properly-designed position limits[58] that helped to ensure sufficient market liquidity for bona fide hedgers and sufficient flexibility for market participants in general.[59]

The CFTC has long established and enforced speculative position limits consisting of three primary components: (1) the threshold that restricts the number of speculative positions that a person may hold in the spot-month, each individual month, and all months combined; (2) exemptions for positions that constitute bona fide hedging transactions; and (3) rules to determine which accounts and positions a person must aggregate for the purpose of determining compliance with position limits ("aggregation of positions").[60] Position limits are widely used: most physical delivery and many financial contracts in CFTC-regulated markets are subject to speculative position limits.[61] In order to deter and prevent squeezes, corners, and similar attempts at manipulation, the CFTC generally sets stricter position limits

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[55] Commodity Futures Trading Commission, "Position Limits for Derivatives," January 26, 2011, 76 FR 4752, at p. 4755.

[56] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p. 29, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[57] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p. 23, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[58] Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed on September 11, 2018; Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at pp. 71644-71645; Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p. 20, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[59] Commodity Futures Trading Commission, 81 FR 96704 at pp. 96832.

[60] "The Commission's existing aggregation policy under regulation 150.4 generally requires that unless a particular exemption applies, a person must aggregate all positions and accounts for which that person controls the trading decisions with all positions and accounts in which that person has a 10 percent or greater ownership interest, and with the positions of any other persons with which the person is acting pursuant to an express or implied agreement or understanding." Commodity Futures Trading Commission, "Aggregation of Positions," 81 FR 91454, p. 91454, December 16, 2016.

[61] Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed on September 11, 2018.

for physically-settled energy contracts than for cash-settled energy contracts, and likewise sets stricter position limits for the spot month than for months further from contract expiration and delivery.[62] Due to RINs' status as a scarce asset that must be physically delivered to the EPA by the compliance deadline, RINs are analogous to physically-settled energy contracts.

Some market participants[63] now oppose the expansion of position limits despite their widespread use,[64] citing concerns about position limits affecting trader flexibility[65] or constraining market liquidity.[66] However, though concerns about position limits affecting trader flexibility and market liquidity are relevant in futures and options markets, they are less relevant in the RIN market due to RINs' distinguishing features as regulatory compliance instruments, particularly (1) RINs' single commercial end use as a means to demonstrate compliance and (2) the RIN market's structure resulting in a number of long entities producing substantially more RINs than they can possibly use to meet their RVOs. Due to the former, any position limit in excess of an entity's RVO—meaning any position limit with a well-designed hedge exemption—provides that entity with enough flexibility for compliance. Due to the combination of the former and the latter, position limits have the potential to increase RIN market liquidity rather than decrease it: by limiting the extent to which the entities naturally long RINs can accumulate positions substantially in excess of their RVOs, position limits would encourage natural longs to make their excess RINs available to the market. In the RIN market position limits that decrease longs' excess RIN holdings beyond their RVOs would force an increase in RINs made available to the market, where they could be purchased by other market participants and used to meet shorts' RVOs.

The CFTC has provided guidance to exchanges regarding setting position limits for energy markets using a formula based on open interest and estimated deliverable supply.[67] The CFTC's "Acceptable Practices under Core Principle 5" specifies that spot month levels for physical delivery markets in general should be based upon an analysis of deliverable supplies and the history of spot month liquidations.[68] The CFTC generally uses telescoping position limits in contracts for physical delivery such that position limits become stricter as the delivery month approaches. For example, the CFTC has indicated that "spot month position limits should be set at a level no greater than necessary," i.e., sufficient to meet all potential bona fide hedging needs, "to minimize the potential for manipulation or distortion."[69] In general, most CFTC position limits are applied symmetrically to both longs and shorts by being based on net positions beyond

[62] Commodity Futures Trading Commission, "Proposal to Set Position Limits in the Energy Futures and Options Markets," available at https://www.cftc.gov/sites/default/files/idc/groups/public/@newsroom/documents/file/energyrrulefactsheet.pdf.

[63] See, for example, Janice Raburn, "Re: EPA-HQ-OAR-2018-0167" Comment Letter, BP America Inc., August 17, 2018.

[64] "Approximately 55 commenters requested that the Commission either significantly alter or withdraw the proposal" to expand position limits. Commodity Futures Trading Commission, "Position Limits for futures and Swaps," 76 FR 71626, at p. 71626, November 18, 2011.

[65] 76 FR 71626, at p. 71640.

[66] 76 FR 71626, at p. 71634.

[67] For example, the CFTC has proposed that energy commodity futures have a spot-month position limit set at 25 percent of estimated deliverable supply. In other months, position limits are set as a proportion of open interest. Commodity Futures Trading Commission, "Proposal to Set Position Limits in the Energy Futures and Options Markets," available at https://www.cftc.gov/sites/default/files/idc/groups/public/@newsroom/documents/file/energyrrulefactsheet.pdf.

[68] Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed on September 11, 2018.

[69] Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed on September 11, 2018.

hedge exemptions as a proportion of deliverable supply, which in the RIN market context would mean evaluating RIN holdings net of RVO obligations as a proportion of deliverable supply. The EPA could consult with the CFTC and exchanges regulated by the CFTC on the methodology to determine the appropriate level for speculative position limits and bona fide hedge exemptions.

The RIN market already utilizes a 20% RIN carryover limit, which is similar to position limits in CFTC-regulated markets. However, the carryover limit applies only to RINs used to demonstrate compliance and not to holdings or position size. Under the carryover limit, RINs may be used only in the compliance year they were produced or the subsequent compliance year, and no entity may use more than 20% prior year RINs to satisfy its RVO.[70] This limit directly constrains only obligated parties by restricting how they demonstrate compliance with RVOs. It does not constrain longs who produce more RINs than needed to meet current year RVO + 20% of subsequent year RVO[71] unless aggregate RINs in excess of 20% of aggregate subsequent year RVO for the entire market are carried over, which has not occurred.[72] There is no limit on how many RINs an *individual* entity may hold or how large of a position an individual entity can carry over into the subsequent year. Consequently, the RIN market in practice has an asymmetric position limit assessed at commercial end use (when demonstrating RVO compliance) that constrains only shorts.

4.2.1. Preventing Excessive Speculation

The CFTC noted that it considers "sudden or unreasonable fluctuations or unwarranted changes in the price" of commodities to be a potential indicator of "excessive speculation" that impose "an undue and unnecessary burden on interstate commerce in such commodity."[73] In other words, the CFTC considers high volatility of prices and price changes that are not explained by underlying supply and demand to be potentially indicative of excessive speculation.[74]

The CFTC has indicated that "position limits would help to diminish or prevent unreasonable fluctuations or unwarranted changes in the price of a commodity" by limiting "the market power that often typifies excessive speculation,"[75] since properly-designed position limits would prevent any market participant from accumulating "an unusually large speculative position [that] could exert unreasonable market power."[76] The CFTC has also suggested that position limits "may serve as a prophylactic measure that reduces market volatility due to large trades that impact prices" even in the absence of manipulative intent by preventing the large positions and associated large trades that can drive market volatility.[77] In other

[70] See 40 CFR 80.1127.

[71] 40 CFR 80.1127 only applies to obligated parties. There is no specification or limit to how many RINs an individual party, including a non-obligated party, can hold past the first compliance year for a given vintage RIN.

[72] The EPA reports the annual total volume of carryover RINs as a percent of total proposed RVO, and this figure has been below 20 percent in recent years. See 83 FR 32030, 82 FR 58494.

[73] Commodity Futures Trading Commission, "Position Limits for Derivatives," January 26, 2011, 76 FR 4752, at p. 4753.

[74] *See* Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at pp. 71627, 71674-5. *See also* Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm.

[75] Commodity Futures Trading Commission, "Position Limits for Derivatives," December 12, 2013, 78 FR 75680, at p. 75691.

[76] Commodity Futures Trading Commission, "Position Limits for Derivatives," December 30, 2016, 81 FR 96704, at p. 96842.

[77] Commodity Futures Trading Commission, "Position Limits for Derivatives," December 30, 2016, 81 FR 96704, at p. 96842.

words, by limiting the size of positions relative to hedging demand or supply, regulators have reasoned that position limits can prevent or reduce the incidence of imbalances in supply and demand that are characteristic of excessive speculation and associated with unreasonable or unwarranted price volatility.

This white paper's analysis confirms prior studies' conclusions that RIN prices are highly volatile.[78] Moreover, the prior studies show that even high RIN prices are not resulting in the expansions to higher blend fuels that were expected by policymakers as a primary objective of imposing the RVO on refiners.[79] The studies suggest that the failure of high RIN prices to incentivize infrastructure investment results in an inelastic, tiered RIN supply curve interacting with a highly inelastic RIN demand curve. This could result in substantial price increases in response to large speculative positions in excess of compliance obligations, or hoarding as discussed above. The empirically observed high volatility and the potential for unreasonable fluctuations in prices in the RIN market from hoarding are consistent with the CFTC's definition of excessive speculation, which the CFTC identified as a justification for position limits, drawn from section 4a(a) of the CEA.[80] Moreover, the Carbon Markets Working Group, which as noted above was chaired by the Chairman of the CFTC and included the Administrator of the EPA as a member, studied markets analogous to the RIN market and issued a report concluding that "excessive speculation can lead to market distortions, and regulatory oversight needs to ensure that such activity remains within prudent levels,"[81] and that position limits were an appropriate regulatory tool for such purposes.[82]

4.2.2. Deterring and Preventing Market Manipulation

In setting position limits, particularly for "spot-month" or delivery month positions, the CFTC "considers whether the specified contract terms and conditions may result in a deliverable supply that is sufficient to ensure that the contract is not conducive to price manipulation or distortion."[83] The CFTC defines

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[78] NERA Economic Consulting, "Effects of Moving the Compliance Obligation under RFS2 to Suppliers of Finished Products," July 27, 2015, p. 32, available at https://www.nera.com/content/dam/nera/publications/2015/Valero%20Report_RFS2_FINAL_July_2015.pdf.

Charles River Associates, "Ethanol RIN Waiver Credits: Improving Outcomes of the Renewable Fuels Standard through a Price Containment Mechanism" March 2018, p. 1, available at http://www fuelingusjobs.com/library/public/CRA_RIN_PriceContainment_March_2018.pdf.

[79] NERA Economic Consulting, "Effects of Moving the Compliance Obligation under RFS2 to Suppliers of Finished Products," July 27, 2015, pp. 16-23, available at https://www.nera.com/content/dam/nera/publications/2015/Valero%20Report_RFS2_FINAL_July_2015.pdf.

Charles River Associates, "Ethanol RIN Waiver Credits," March 2018, pp. 9-12, available at http://www fuelingusjobs.com/library/public/CRA_RIN_PriceContainment_March_2018.pdf.

[80] Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm; 7 U.S.C. § 6a(a), available at https://www.law.cornell.edu/uscode/text/7/6a.

[81] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p. 23, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[82] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, pp. 20,29, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[83] Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at p. 71633.

"deliverable supply" as "the quantity of the commodity meeting a derivative contract's delivery specifications that can reasonably be expected to be readily available to short traders and saleable by long traders at its market value in normal cash marketing channels at the derivative contract's delivery points during the specified delivery period[.]"[84]

The CFTC has traditionally adopted "telescoping" position limits such that position limits become more strict for spot months than non-spot months, implicitly recognizing that contract hoarding near the delivery period can facilitate market manipulation to a greater extent than hoarding further from the delivery period.[85] The CFTC has noted that position limits "deter and prevent corners and squeezes" near the delivery date because they "make it more difficult to mark the close" with large trades close to delivery, which can "spoil[] convergence between futures prices and spot prices at expiration."[86] In essence, policy makers have posited that properly-designed position limits prevent or reduce the incidence of large speculative positions near delivery dates that can create shortages or excesses in deliverable supply that in turn create artificial prices that do not reflect the actual supply and demand conditions.

In the RIN market, the analogous market feature is the annual compliance deadline and the month immediately prior to the compliance deadline (rather than a "spot-month" or a delivery period). Telescoping position limits in the RIN market could gradually get stricter as the compliance deadline approaches, with a particularly strict position limit, tied directly to a firm's RVO, in the month prior to the compliance deadline. As the RIN market encompasses substantial forward and derivative transactions, and the potential for coordination among affiliated traders is non-trivial, the EPA could develop RIN position aggregation policies modeled on the CFTC's policies for aggregation of positions, which look at aggregate physical and financial positions in related products across affiliates to reduce the risk of market manipulation across markets or by coordinated trading among affiliated traders.[87]

The California Greenhouse Gas Emissions Cap-and-Trade Market is directly analogous to the RIN Market, in that both it and the RIN market involve trading in allowances used to meet regulatory compliance requirements. Both markets' allowances are closely connected with the energy markets as well. The California Greenhouse Gas Emissions Cap-and-Trade Market maintains position limits (referred to as "holding limits")[88] in order to "prevent market participants from taking unilateral actions to move [the] price of allowances and profit from this price change."[89] These holding limits were modeled in part on CFTC position limits, as it was understood that the market in regulatory allowances was "expected to generate derivatives markets falling under the jurisdiction of the Commodity Futures

[84] Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at p. 71633.

[85] Commodity Futures Trading Commission, "Speculative Limits," available at https://www.cftc.gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm.

[86] Commodity Futures Trading Commission, "Position Limits for Derivatives," December 30, 2016, 81 FR 96704, at p. 96842.

[87] *See* Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at p. 71678.

[88] California Air Resources Board, "Facts about Holding Limit for Linked Cap-and-Trade Programs," December 1, 2017, available at https://www.arb.ca.gov/cc/capandtrade/holding_limit.pdf.

[89] California Greenhouse Gas Emissions Cap-and-Trade Market, "Emissions Market Assessment Committee Meeting," November 14, 2013, p. 2, available at https://www.arb.ca.gov/cc/capandtrade/emissionsmarketassessment/holding-limits.pdf.

Trading Commission."[90] In addition, the Carbon Markets Working Group concluded that "through the use of position limits and monitoring of participant positions, regulators would be in a position to reduce the possibility of manipulations and market disruptions"[91] in markets for regulatory allowances.

The California Greenhouse Gas Emissions Cap-and-Trade Market's reasoning regarding position limits applies equally to the RIN market, which has spawned financial derivatives markets on multiple exchanges, as referenced in Section 2.2 and in footnote 22.[92] Although these exchange-traded contracts have not been embraced by all RIN market participants, it may be beneficial for market integrity and price discovery for exchange-traded contracts to play a larger role in the market. As revealed by post-Dodd-Frank regulatory oversight and exchange trading of products that were previously traded primarily in unregulated and OTC markets, a paucity of regulation and diligent oversight in opaque markets dominated by chat rooms and instant messenger negotiations can allow manipulation and fraud to thrive.

4.2.3. Hedge Exemptions to Ensure Sufficient Market Liquidity to Facilitate Hedging

The CFTC has frequently stated its support for hedge exemptions to position limits, which allow commercial end users to accumulate positions larger than would be permitted by applicable position limits to the extent that such positions offset commercial price risks. In practice, the CFTC has designed its position limits programs with allowances for commercial end users to use bona fide hedge exemptions to the limits for those positions used to hedge or mitigate price risk arising from a change in the hedger's current or anticipated assets or liabilities.[93] This provides commercial market participants with the ability to maintain positions large enough to hedge commercial risks without facilitating excessive speculation by financial market participants, and prevents commercial market participants from engaging in excessive speculation beyond their hedging needs. In short, hedge exemptions are designed with the intent to ensure that position limits prevent excessive speculation while allowing financial market participants to provide liquidity.

In the context of the RIN market, the analogous market participants to end users are entities with substantial RVOs, and RIN positions used to meet current or anticipated RVOs would be akin to bona fide hedges, in that those RINs are used to hedge compliance risk associated with meeting compliance requirement liabilities. Telescoping position limits with RVO-based hedging exemptions can be applied to ensure that entities that are substantially long RINs relative to their RVOs are regularly making RINs available to the market. This would be expected to increase market liquidity for hedgers attempting to

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[90] California Environmental Protection Agency, "Facts About Cap and Trade: Market Oversight and Enforcement," November 1, 2011, p. 2, available at https://www.arb.ca.gov/html/fact_sheets/cap_trade_market_oversight.pdf.

[91] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p. 29, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[92] *See* InterContinental Exchange, "California Carbon Allowance Vintage 2018 Future," available at https://www.theice.com/products/31687043/California-Carbon-Allowance-Vintage-2018-Future; CME Group, "California Carbon Allowance Vintage-Specific Futures," available at https://www.cmegroup.com/trading/energy/emissions/california-carbon-allowance-vintage-specific-futures html. *See also* InterContinental Exchange, "Gasoline Outright – D6 RINs (OPIS) Current Year Future," available at https://www.theice.com/products/68361253/Gasoline-Outright-D6-RINs-OPIS-Current-Year-Future; CME Group, "Trade Biofuel Products," available at https://www.cmegroup.com/trading/agricultural/biofuel html.

[93] Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at pp. 71644-5.

meet their RVOs because there are no alternative commercial end uses for RINs besides retirement to demonstrate compliance with RFS2 RVOs and each RVO-obligated entity is constrained by the two-year RIN lifespan and the 20% limit on the use of prior year RINs to meet current year compliance requirements. Entities that produce RINs or acquire RINs substantially in excess of their RVOs have no legitimate commercial reason to hold RINs in excess of current year RVO + 20% of next year's expected RVO as the current year's compliance date approaches. In addition, due to the nature of RINs, position limits would force an increase in liquidity, as excess RINs produced by natural longs under the RFS2 mandate would have to be made available to natural shorts in order to comply with position limits. In effect, position limits with hedge exemptions in the RIN market would ensure an increase in transaction volumes. This would be consistent with both the CFTC's utilization of telescoping position limits with hedge exemptions in commodity markets and the Carbon Markets Working Group's conclusion that appropriate hedging exemptions in regulatory compliance instrument markets are a key aspect of position limits as a regulatory tool.[94]

4.3. Central Repository and RIN Auctions

A central repository for RINs that holds periodic auctions could help improve liquidity, mitigate market fragmentation, and provide a centralized forum for periodic price discovery. Concerns about market fragmentation, market quality, and price discovery suggest that the RIN market may benefit from periodic centralized auctions of RINs. Such auctions, with established precedents in emissions cap-and-trade markets, and renewable energy certificate ("REC") markets, would provide for centralized price discovery across different vintages of RINs and reduce transaction costs and search costs around each auction. In emissions cap-and-trade markets, such auctions are generally the mechanism by which allowances enter the market. In REC markets, such auctions can be used as a means to ensure liquidity and improved market function for allowances produced by private actors' actions.

The RIN market is analogous to REC markets, in that RINs are produced as a product of private actors' actions (producing biofuels). The RIN market also displays many of the issues that have been observed in REC markets. Auctions acting as a guaranteed site of liquidity and price discovery have been found to improve REC market quality substantially relative to allowing only OTC secondary trading of RECs.[95]

The RINs to be auctioned could come from several sources, including:

(a) Voluntary secondary market participation by registered entities;

(b) Valid RINs in excess of position limits or carryover limits (these could be required to be auctioned off as the compliance mechanism for the position limits regime);

[94] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p. 20, available at https://www.cftc.gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811.pdf.

[95] Edward Holt, Jenny Sumner, and Lori Bird, "The Role of Renewable energy Certificates in Developing New Renewable energy Projects," National Renewable Energy Laboratory, June 2011, pp. 26-27, available at https://www.nrel.gov/docs/fy11osti/51904.pdf.

(c) Valid RINs that would expire unused (these could be transferred to a central repository, granted a waiver to allow for their use in one additional compliance year, and then auctioned off); and

(d) Valid RINs that would be retired due to industrial accidents such as spills (these could instead be auctioned off, recognizing that since the relevant fuels were produced and capital investments to make those fuels were made, industrial accidents need not automatically result in a shifting of the supply curve left, mitigating a potential jump in RIN prices).

Such auctions have substantial precedent both around the world and in EPA's own practices. In other regulatory compliance instrument markets, such as Title IV markets, the EPA has used auctions and direct sales of regulatory compliance instruments to obligated parties to increase "the availability of allowances" and "ensure the economic efficiency" of those markets.[96] In Title IV markets, the EPA has also previously taken regulatory compliance instruments from market participants in predetermined circumstances in order to auction them off while guaranteeing those market participants the proceeds from the auction.[97]

5. Conclusion

This study presents NERA's analysis of D6 RIN market quality and dynamics under RFS2. NERA identified several market problems including high volatility, illiquidity, evidence of high and volatile transaction costs, irrational negative time value pricing relationships, evidence of rapid D6 RIN price convergence to (and rapid divergence from) the D4 RIN price, and a lack of adequate public data. These issues all harm market quality in the RIN market, resulting in an inefficient and fragmented market. These market shortcomings compromise market integrity and could create incentives to engage in hoarding.

This study also developed potential policy reforms to alleviate the identified problems, drawing upon methods effectively used by other regulators to foster better-functioning markets. The EPA would benefit from a position data reporting regime modeled on the CFTC's Large Trader Reporting Program that covers both physical and derivative positions. Another reform that the EPA may consider to help alleviate RIN market quality problems would be the establishment of position limits set proportional to entities' RVOs. Limits applied symmetrically would follow longstanding precedent in other energy commodity markets, such as those regulated by the CFTC, and would follow the EPA's own precedent in establishing effective limits on carryover RINs. Finally, RIN auction facilities could be considered as a means to provide a regular source of centralized price discovery and liquidity.

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96 Environmental Protection Agency, "Acid Rain Program, SO2 Allowance Auction and Electronic Allowance Transfer," 61 FR 28996, June 6, 1996.

97 Environmental Protection Agency, "Auctions, Direct Sales, and Independent Power Producers Written Guarantee Regulations," December 1991, available at https://nepis.epa.gov/Exe/ZyNET.exe/9100Z4HB.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1991+Thru+1994&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C91thru94%5CTxt%5C00000026%5C9100Z4HB.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL#.

Appendix A. Transparency

Data Reporting Requirements and Availability in the RIN Market in Comparison to Similar Markets

Data Category	RIN Market	Commodity Futures and Options	Commodity Swaps	U.S. State and Regional Carbon Allowances
Regulatory Reporting Requirements	The EPA collects limited data through the EPA Moderated Transaction System (EMTS), primarily RIN generation, separation, retirements, and RIN transfers of title. The EPA does *not* generally collect data on the forward and/or swap transactions that dominate the RIN market, or on associated financial positions in RINs.[1]	The CFTC operates a comprehensive information collection system from market participants, including market data (on transactions, time and sales, prices, quotes, and volumes) and both financial and physical position data.[4] The data collected by the CFTC is used to supervise and monitor market integrity, market volatility, and compliance with speculative position limits and capital requirements.[5]	Following the enactment of the Dodd-Frank Act, the CFTC requires that most swaps transactions be reported to Swap Data Repositories (SDRs) and made available to the CFTC. Such swap data generally required to be reported to SDRs and the CFTC include economic terms of transactions, the identities of the counterparties, and information on clearing entities, if applicable.[9]	U.S. State and Regional Carbon Allowances markets, such as the Regional Greenhouse Gas Initiative and the California Cap-and-Trade Program, collect data on emissions (which determine obligations), allowance distributions and holdings, and centralized repository auction results, including the identities of bidders.[12]
Data Commercially Available to Market Participants	Data vendors such as Argus and OPIS receive RIN price and volume data submissions from brokers and/or traders in a portion of the RIN market, but the data are not complete, are less reliable because they rely on voluntarily self-reported data, and are commonly limited to spot prices.[2]	Exchanges and data vendors offer spot and forward prices, trade volumes, intra-day trade prices and quotes, top-of-book trading floor data, daily quote and exchange message statistics, event-based market data including quantities associated with posted quotes.[6] Sufficient data are available on liquid products to allow market participants to engage in quantitative modeling and trading of exchange-traded commodity futures and options.	For cleared swap futures, exchanges offer daily (or more frequent) data regarding the contracts, last price, change from previous price, open, high, and low prices for the day, and cleared volume. Data are often available for multiple tenors, providing market participants with forward price and volume information.[10]	Both California and RGGI Carbon Allowances futures are traded, allowing subscribers to access standard commodity futures exchange data products regarding financial product prices and volumes across the forward curve.[13]
Data Available to the Public	The EPA publishes annual and monthly aggregates regarding RIN generation, retirements, separation, and "availability," as well as annual sales/holdings and compliance data. Sales data have not been updated since 2014 and holdings data have not been updated since 2015. The EPA does *not* publish any information regarding financial transactions in RINs, and sales data only cover transfers of title.[3]	The CFTC publishes anonymized aggregates of market and position data for the public, such as the CFTC's longstanding Commitments of Traders reports, which break down some data aggregates by market participant type.[7] Exchanges also publish the most recent completed trading day's summary data, such as settlement price, change from last settlement price, volume, and open interest, usually broken out by tenor.[8]	The CFTC publishes a Weekly Swaps Report that informs the public about the notional amounts outstanding in SDRs, weekly transaction dollar amounts, and trade event volumes, broken down by market participant type, cleared status, product type, as well as product currency, tenor, and grade where applicable.[11]	The California and RGGI auctions provide aggregate price, bidding, and volume information to the public, and the programs allow the public to see transaction-level price and volume data, as well as participant-level compliance requirements and compliance reports requisite to modeling end-use supply and demand curves.[14]

Notes and Sources:

[1] Environmental Protection Agency, "Renewable Identification Number (RIN) Data for Renewable Fuel Standard Program," available at https://www epa gov/renewable-fuel-standard-program/renewable-identification-number-rin-data- renewable-fuel-standard, accessed 5 Sep 2018

[2] *See, for example,* OPIS, "OPIS Renewable Fuels/RIN Credits," available at https://www opisnet com/wp-content/uploads/2018/01/OPIS-RenewableFuels-RINCredits pdf, accessed 5 Sep 2018

[3] Environmental Protection Agency, "Public Data for the Renewable Fuel Standard," available at https://www epa gov/fuels-registration-reporting-and-compliance-help/public-data-renewable-fuel-standard, accessed

5 Sep 2018

[4] Commodity Futures Trading Commission, "Large Trader Reporting Program," available at https://cftc gov/IndustryOversight/MarketSurveillance/LargeTraderReportingProgram/index htm, accessed 5 Sep 2018

[5] *See* Commodity Futures Trading Commission, "Speculative Limits," available at https://cftc gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed
5 Sep 2018

[6] *See* CME Group, "Market Data," available at https://www cmegroup com/market-data html, accessed 5 Sep 2018

[7] Commodity Futures Trading Commission, "Commitments of Traders," available at https://cftc gov/MarketReports/CommitmentsofTraders/index htm, accessed 5 Sep 2018

[8] *See, for example,* CME Group, "Crude Oil Futures Settlements," available at https://www cmegroup com/trading/energy/crude-oil/light-sweet-crude_quotes_settlements_futures html, accessed
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[9] Commodity Futures Trading Commission, "Weekly Swaps Report," available at https://cftc gov/MarketReports/SwapsReports/index htm, accessed 5 Sep 2018

[10] CME Group, "Swap Futures," available at https://www cmegroup com/trading/interest-rates/mac-swap-futures html, accessed 5 Sep 2018

[11] Commodity Futures Trading Commission, "Weekly Swaps Report," available at https://cftc gov/MarketReports/SwapsReports/index htm, accessed 5 Sep 2018

[12]*See, for example* , *Regional Greenhouse Gas Initiative,* "CO2 Budget Source 2018 Interim Control Period Compliance Process Checklist," available at https://www rggi org/sites/default/files/Uploads/Compliance-Materials/RGGI_2018_Interim_Compliance_Checklist pdf, accessed 5 Sep 2018

[13] *See, for example,* InterContinental Exchange, "Regional Greenhouse Gas Initiative Vintage 2018 Future," available at https://www theice com/products/55410815/Regional-Greenhouse-Gas-Initiative-Vintage-2018-Future, accessed 5 Sep 2018

[14] *See* Regional Greenhouse Gas Initiative, "RGGI COATS," available at https://www rggi org/allowance-tracking/rggi-coats, accessed 5 Sep 2018; *See also* Regional Greenhouse Gas Initiative, "Auction Results," available at https://www rggi org/auctions/auction-results, accessed 5 Sep 2018

Appendix B. Position Limits

Objectives	RIN Market	Commodity Futures Trading Commission	U.S. State and Regional Carbon Allowances
Preventing Excessive Speculation	The RIN market is highly volatile, and studies suggest that the demand curve is highly inelastic while the supply curve is inelastic and/or tiered.[98] This would allow hoarding to cause sharp fluctuations in RIN prices. Position limits could address this.	The CFTC imposes speculative position limits on most physical delivery markets and many related financial markets in order to prevent sudden or unreasonable fluctuations or unwarranted changes in prices, as encouraged under Section 4a(a) of the CEA.[99]	The Interagency Working Group for the Study on Oversight of Carbon Markets ("Carbon Markets Working Group") concluded that "excessive speculation can lead to market distortions, and regulatory oversight needs to ensure that such activity remains within prudent levels."[100]
Deterring and Preventing Market Manipulation	No current mechanism exists to ensure sufficient deliverable supply of RINs in the month before compliance deadlines, which could facilitate market manipulation. Position limits tailored to reflect compliance obligation hedging demands could address this.	The CFTC generally imposes stricter position limits in the spot-month or delivery month than in other months as part of a "telescoping" position limits program designed to ensure sufficient deliverable supply as delivery dates approach.[101]	The California Greenhouse Gas Cap-and-Trade Market, which is analogous to the RIN market, utilizes "holding limits" modeled on CFTC position limits in order to deter and prevent market manipulation.[102] The Carbon Markets Working Group also concluded that "through the use of position limits and monitoring of participant positions, regulators would be in a position to reduce the possibility of manipulations and market disruptions."[103]
Exemptions to Promote Sufficient Liquidity for End User Hedging	The RIN market has no mechanism ensuring sufficient RIN liquidity throughout the year to allow effective hedging to meet RVO compliance requirements. Telescoping position limits could address this.	The CFTC grants exemptions to their position limits for bona fide hedges that reduce or offset price risk arising from a change in the hedger's current or anticipated assets or liabilities.[104] The RIN market analogue is a position held to meet the current or expected RVO.	The Carbon Markets Working Group stated that appropriate hedging exemptions are a key aspect of position limits as a regulatory tool.[105]

[98] NERA Economic Consulting, "Effects of Moving the Compliance Obligation under RFS2 to Suppliers of Finished Products," July 27, 2015, pp 16-23,32, available at https://www nera com/content/dam/nera/publications/2015/Valero%20Report_RFS2_FINAL_July_2015 pdf Charles River Associates, "Ethanol RIN Waiver Credits," March 2018, pp 1,9-12, available at http://www fuelingusjobs com/library/public/CRA_RIN_PriceContainment_March_2018 pdf

[99] Commodity Futures Trading Commission, "Speculative Limits," available at https://www cftc gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed on September 11, 2018

[100] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p 23, available at https://www cftc gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811 pdf

[101] Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at p 71633

[102] See California Environmental Protection Agency, "Facts About Cap and Trade: Market Oversight and Enforcement," November 1, 2011, available at https://www arb ca gov/html/fact_sheets/cap_trade_market_oversight pdf See also California Greenhouse Gas Emissions Cap-and-Trade Market, "Emissions Market Assessment Committee Meeting," November 14, 2013, p 2, available at https://www arb ca gov/cc/capandtrade/emissionsmarketassessment/holding-limits pdf See also California Air Resources Board, "Facts about Holding Limit for Linked Cap-and-Trade Programs," December 1, 2017, available at https://www arb ca gov/cc/capandtrade/holding_limit pdf

[103] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p 29, available at https://www cftc gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811 pdf

[104] Commodity Futures Trading Commission, "Speculative Limits," available at https://www cftc gov/IndustryOversight/MarketSurveillance/SpeculativeLimits/index htm, accessed on September 11, 2018; Commodity Futures Trading Commission, "Position Limits for Futures and Swaps," November 18, 2011, 76 FR 71626, at pp 71644-71645

[105] Interagency Working Group for the Study on Oversight of Carbon Markets, "Report on the Oversight of Existing and Prospective Carbon Markets," January 18, 2011, p 20, available at https://www cftc gov/sites/default/files/idc/groups/public/@swaps/documents/file/dfstudy_carbon_011811 pdf

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